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Mining Journal

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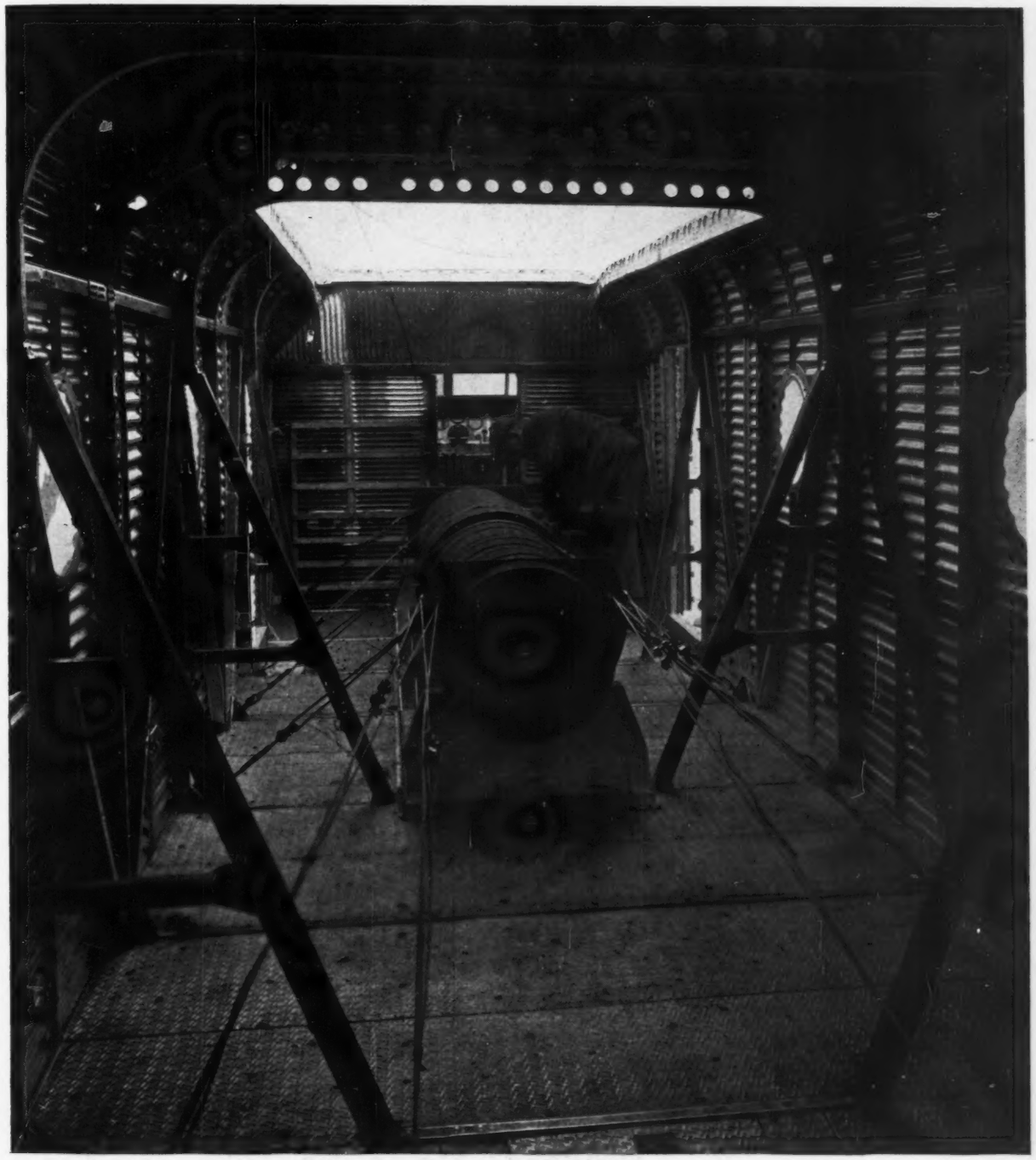
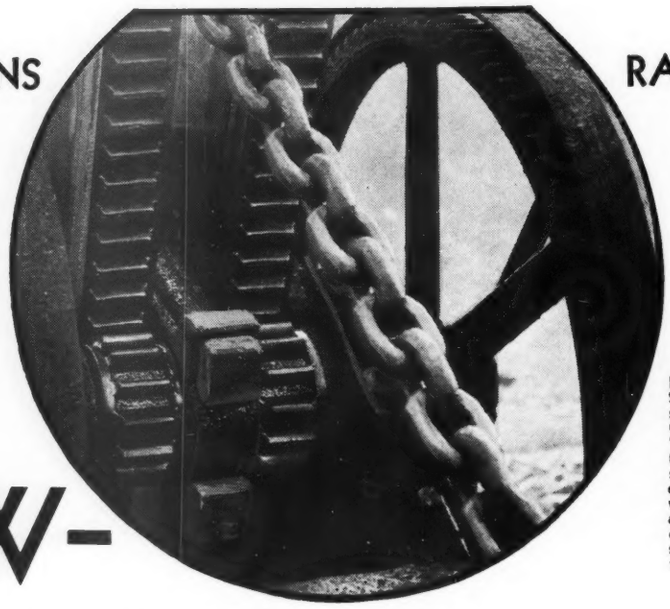


For the hitherto inaccessible mining district—air transport of mining machinery

(*See article on page 379*)

October 23, 1930

RACKS and PINIONS



RACKS and PINIONS

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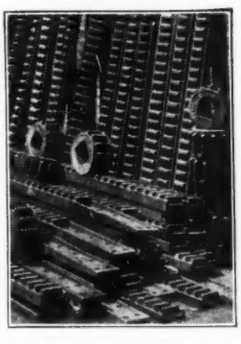

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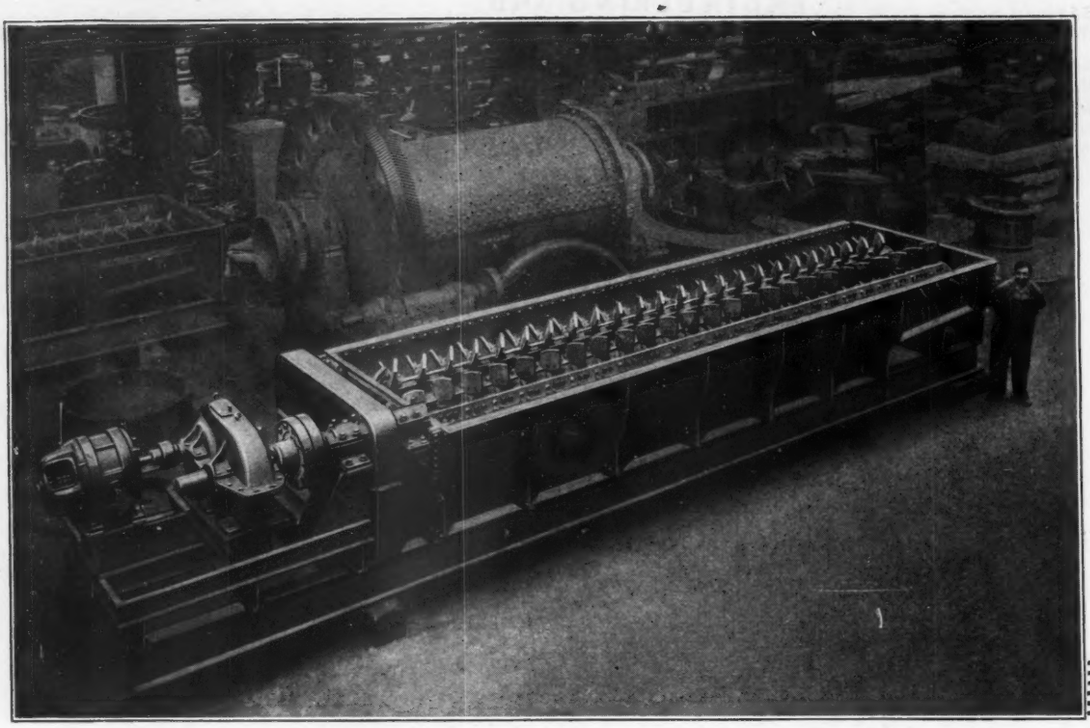

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ENGINEERING AND
MINING
JOURNAL

A. W. ALLEN, *Editor*

VOLUME 130, No. 8

ESTABLISHED 1866

New York, October 23, 1930

Seeking a Solution of the Silver Problem

THE economic position of silver is receiving an unusual amount of attention. On another page of this issue we publish a recommendation in favor of a return to bimetallism, to be applied on a basis that should interest the silver-producing industry. Rated bimetallism—by which a definite ratio of value between two metals is established—was in force in France and the United States early in the nineteenth century, the metals being gold and silver. On the other hand, one of the Russian coins, minted in 1840, pictured in our issue of Sept. 8, carries a legend indicating that "9 zolitnik, 68 dolia Pure Ural Platinum" was equivalent to "12 Rubles in Silver." The increasing production of gold later deflected attention to that metal as the basis of currency, and an international conference accepted it as standard in 1869.

The major argument in favor of bimetallism—that a gold famine was imminent—became less convincing as gold production increased. Now that the output is declining, the subject is again receiving consideration. That distinguished economist and diplomat, Mr. Theodore Marburg, an advocate of bimetallism, is against individual action by the United States, however. Instead, he insists, in a letter to the New York *Times* of Oct. 11, that international agreement is essential. "The ratio of the metals is maintained," he explains, "by the privilege to discharge world debts in either metal. The moment one metal falls it is sought and the other neglected by men who have payments to make, and the demand for the lower metal thus immediately restores the parity." Platinum, Mr. Marburg reminds us, "could advantageously be added to the money group at a fixed ratio." Trimetallism—to coin a new word—is therefore within the purview of practical politics.

In the meantime, however, the United Press reports that France, although making no move in the direction of bimetallism, is reverting to the coinage of silver in large quantities. Paper money is being replaced by silver coin, and the vast amount of gold that has accumulated in recent years is to remain in storage. Such items are heartening to the silver miner, who is also evincing interest in the proposal that several of the leading nations, especially those which are vitally concerned in stimulating the consumption of silver, with an eye also on the market opportunities offering in the Orient, should make a large loan to China, in the form of metallic silver. This plan, if consummated, would have a stabilizing and strengthening effect on the Chinese political situation, and its sponsors would expect a stimulation of trade. The transfer of several hundred million ounces of silver thus would relieve the present stagnancy in the silver market.

Future of Safety Movement Depends on Humanitarianism

MUCH information of a definitely practical and useful character was presented at the sessions of the Mining Section of the National Safety Council that were held recently in Pittsburgh. The free exchange of ideas and experiences that took place was one of the most valuable features of the gathering.

Aside from the discussion of the new aids available in accident-prevention endeavor, such as the talking motion picture, physical-examination records, and a psychological study of the worker in connection with injuries, the most important viewpoint expressed seemed to be the increasing significance of the humanitarian aspect of safety work. For instance, one speaker said that, to succeed in accident prevention, the safety engineer must convince the workers that he is more interested in their safety and the welfare of their families than he is in the possible benefits accruing to the company. Mr. W. V. DeCamp, general manager, United Verde Copper Company, in his paper "Safety Responsibility of Management," pointed out that the safety of the worker is a humanitarian obligation of management. "Do not forget for a moment," he says, "that as an employer you are your brother's keeper. . . . Sound educational methods," he adds, "should be conducted continuously, and they should be started among the school children in your community. Even though we may not attain the maximum success with the present generation, we can hope for a better response from the coming generation."

This statement by Mr. DeCamp certainly presents a long-range view of safety. If the present toll of accidental deaths in the United States is to be reduced, his view expresses the logical course to pursue. The

thought requires a humanitarian approach to the safety problem, for whether or not the financial expense involved in educating the children of a given community in safety will ultimately be an economical investment for the mining company in that community is debatable. Although, if each mining company, each industry, and every other agency that together comprise the business world would assume its individual obligations in this respect, each company, each industry, and every agency would probably benefit. This contingency cannot, of course, be relied upon or made the motivating force in the adoption of any such safety program. Nevertheless, intensive education in safety should be given to the school children of the country, as well as to adults, particularly in view of the increasing application of the machine. Moreover, safety practice as applied to the operations of the individual units of the various industries has been proved to pay. Ample evidence is available on this point. Safety endeavor on a broader scale in industry is now required. At the moment it may not seem to pay. But who can gage its importance a decade or so hence? Those who are trying to look into the future and who will first discern its form are now considering safety from the humanitarian viewpoint. Profit is usually associated with foresight. This instance will probably prove no exception.

With Costs, Many a Mickle Makes a Muckle

ORE transport underground is an important part of the mining operation when the latter is considered as a whole. Its relative position is indicated by the percentage of the total underground expense that its cost represents. Figures recently published by the United States Bureau of Mines, in a summary by Mr. Charles F. Jackson, show this to be 28.40 per cent on an average for fifteen mines having open stopes; 20.2 for seven mines and 22.65 for nineteen mines using shrinkage stopes; 21.03 for three mines using block caving; 13.83 for five mines having square-set stopes; and 12.9 for four mines using cut-and-fill. Expressed in dollars per ton of ore hoisted, these figures are more illuminating, being, respectively, $0.303, $0.516, $0.1135, $0.612, and $0.4025 for the five classes listed. In other words, in 50 of the 53 widely scattered mines included, it cost from 30 to 61 cents to move a ton of ore from stope to surface, this including tramming, hauling, dumping, caging, and hoisting of ore, as well as the handling of materials, tools, supplies, and waste rock.

Any improvement, in equipment or in operation, that can be devised to lower the figures given will naturally be seized upon by progressive executives. Every cent saved per ton on the output of a mine means an appreciable addition to annual profits. The multiple represented by the annual tonnage is a potent factor in making small savings amount to important sums. Herein lies the reason why the use of such improvements as anti-friction bearings for mine cars has become standard practice in many mines. Every ton of ore extracted underground has to move on wheels over almost the entire horizontal distance between the face, where it is broken, and the shaft or the tunnel portal, where it comes to surface. The cost of maintaining and lubricating cars, and the amount of power required to haul them, are reduced by use of anti-friction bearings, as many a mine executive can testify.

Reducing the Fluctuations in Employment

THE superintendent of a metallurgical plant recently made the following remark to a visitor: "Well, we have the same machine shop as when you were here nine years ago. We have had no chance to enlarge it, but we have been getting along by working three shifts. The blacksmith shop is the same too." This in spite of the fact that the output of the plant had been almost doubled during these years. A suggestion that the present would be an appropriate time to make much-needed additions to shop facilities—the plant meanwhile operating at half capacity, with the men on a five-day week—brought the usual reply: "We can do nothing now. We are making no money."

Adoption of so short-sighted a policy indicates poor business statesmanship and failure to meet responsibility. In striking contrast is the plan to minimize the cause and effect of unemployment, recently put into practice by the General Electric Company, which provides that plant renewal and maintenance work be postponed as far as possible when business is increasing, the men thus released being employed on regular output. When product demand declines, these men are transferred to maintenance and repair, to bring equipment up to a high standard. Increased plant facilities previously planned are completed as far as possible, providing work for men in the organization who otherwise would have had to seek employment elsewhere.

The wisdom of this plan is so obvious that its general acceptance by industry cannot be too strongly urged. An organization able to maintain this policy will be repaid in increased good will and efficiency on the part of its employees, as well as in cash return. Companies that do not provide the capital needed for plant modernization and rehabilitation during periods of diminishing earnings will discover the truth of the old saying that poverty is expensive.

Rapid Reading and Mental Indigestion

READING may be a preliminary or an end. To the individual who requires a mass of factual information to guide him in his work, it gives immediate results. Such a person reads widely to be well informed. In his case, the reflective faculty is called upon only during the course of reading to decide what facts are new and worth remembering. But to the thinker, reading is merely a preliminary, to furnish him with the evidence needed to test or weigh, and thereby to reach some possible conclusion. He who reads much and thinks but little (and his number is legion), runs the risk of falling a prey to the written

word. Herein lies the explanation of the ease with which public opinion may be molded.

The volume of reading that must be done by the professional man or student who would keep posted on developments in his field has frequently been stressed by writers. Chief among them is Prof. W. B. Pitkin, of Columbia, whose "Art of Rapid Reading" attracted wide attention. Professor Pitkin's estimate of the amount of reading, or skimming, an individual can do when properly trained is so large that some may possibly be skeptical of his figures. To every one, however, he gives the chance of proving the truth of his assertions, by practicing certain exercises he specifies. Results are bound to vary with the individual, but anyone striving to increase his speed according to some such definite plan will probably show improvement.

Voluminous reading, even though some of it be only skimming, should yield definite results. It should be reflected in an increased soundness of opinion, in a stronger grasp of the subject covered; and, in addition, where a writer is concerned, in greater productivity. If these results be lacking, what is needed is more reflective thinking rather than more reading. Excessive reading may easily result in mental indigestion.

A Little Light Is Shed on the Gold Shortage

CONFRONTED for a year by the ruins of stock-market speculation and an undeniable trade depression, manifested chiefly in falling commodity prices and widespread unemployment, economists have felt a natural urge to find somewhere, somehow, the horrible cause of it all. A great many have hit upon gold as the sinister and malevolent force that has thrown industry and commerce into near chaos. Gold is the basis of the financial structure of the Western world, a structure that has been growing steadily in size. Current gold production, on the other hand, is considerably below that of 1915, the peak year. In 1929, so the economists say, the inevitable happened—the cord that was attached at one end to a growing financial structure and at the other end to a nearly stagnant gold reserve was snapped.

To this view comes no unanimous chorus of approval. Dissenting economists aver that, were the gold shortage the real cause, the current depression would have been manifested more gradually. They ascribe the collapse to heedless expansion of industry without a corresponding increase in consuming power. Capital—productive capacity—was added without thought to an already overcapitalized structure. Commodity overproduction was sure to result.

On these problems the report recently issued by the Gold Delegation of the Financial Committee of the League of Nations casts interesting light. It does not deal with the immediate crisis, being content to discuss the future of the gold standard. If the reader is to draw any inference from it, however, that inference is that gold reserves are probably adequate at present but will undoubtedly be inadequate in the future, unless production takes a sudden turn upward, or the usefulness of the present reserves is increased. Based on current gold output, a production table, prepared for the delegation by Mr. Joseph Kitchin, indicates that output is likely to decrease from about $400,000,000 this year to about $370,000,000 in 1940.

At present the gold reserves held by the more important gold-standard countries are about 40 per cent of their aggregate note and sight liabilities. Minimum legal requirements in most countries range from 29 to 34 per cent. Banks of issue must normally keep a margin of cover of about 7 to 10 per cent above these requirements, indicating that the present world reserves are sufficient. World trade is expected to increase about 3 per cent annually. If the present 40 per cent cover is maintained, and if non-monetary demand continues at current or slightly higher levels (as is probable), the production in 1940 will be about $238,000,000 short of the annual requirements for monetary purposes. Even if world trade increases only 2 per cent annually, the addition of new gold to the reserve will be $74,000,000 less than it should be.

Few authorities expect gold production to increase materially unless a field comparable in magnitude to the Witwatersrand should be discovered. The prospect of a gold shortage, therefore, is no idle threat. Apprehension need not be too great, however, the report indicates. Remedial measures may be found that will correct the situation for at least the next decade. Of these, the most important and the most obvious is the reduction of the legal minimum cover. The present minimum reserves are the outcome largely of convention and habit, of the natural fear possessed by each individual legislature that a departure from general practice may impair confidence in the currency. Gold must be made more elastic.

For a single country to reduce its gold reserves substantially below the minimum now required by other nations would be foolhardy; but if several of the leading adherents to the gold standard were to act jointly, the delegation believes that a considerable reduction in the ratio of actual gold reserves to outstanding liabilities is possible. The report suggests other means by which the efficiency of a given quantity of gold might be increased. One of these should be a comfort to the silver producer: Small-denomination bank notes now backed by gold reserves might be replaced by token coins that would require no reserve, such as is the case with the silver coinage in the United States. Monetary gold should be concentrated in the reserves of the central banks; and its use, as a means of payment, limited to international transactions.

Although these suggestions are sound—their adoption would prolong for several years at least the use of the present currency system—they must be recognized as providing temporary palliatives only. The day will come, if the price of gold is kept at $20.67 an ounce, when the available reserves of the metal will not be sufficient for the world's trade. Apparently, only three alternatives can then be considered: the price structure of all other commodities will have to be revised downward at the cost of prolonged depression; or the price of gold itself will have to be increased gradually to maintain the commodity-price levels—a delicate adjustment that will call for more co-operation and knowledge than are now available; or, finally, some entirely new method will have to be devised for handling gold or some other standard of value. Meanwhile, adoption of the suggestions made in the delegation's report will measurably lengthen the period of service of the present system, thus permitting additional time for necessary research into the more obscure factors that enter into currency control.

Closing Days of The Smuggler Union

H. S. Worcester

Formerly Superintendent of the Mine

The Smuggler Union mill

IN THIS PUBLICATION of March 31, 1928, Mr. Robert Livermore, president and general manager of the Smuggler Union Mining Company, published an interesting narrative of the events connected with the old Smuggler Union mine, at Telluride, Colo., from 1923 to the time of the destruction of the Pennsylvania Buildings by fire in 1927. This was entitled "Prolonging the Life of the Smuggler Union Enterprise." Subsequent history, with a sketch of the methods used in gaining the ore then developed below the Bullion Tunnel, may be of interest.

The Pennsylvania Tunnel plant was near the mouth of the Pennsylvania Tunnel, to which it was connected by a heavy snowshed. Situated near the creek in the steep and narrow gulch of Marshall Creek, the tunnel portal is directly in the path of the Valley View, Pandora, Oriental, and Ash Dump snowslides. The plant was placed on its precipitous site when built in 1925 because of the snowslide hazard of any point closer to the tunnel portal. Just previous to the fire of Oct. 20, 1927, this plant had been brought up to a tonnage of 700 tons of mine-run ore per day, from which was being delivered to the mill 550 tons of sorted ore. At this time, because of exhaustion of ore reserves above the Bullion level, the upper workings were producing only 250 tons per day of a total mill feed of 800 tons.

To feed this plant its required tonnage, through the crooked narrow tunnel with steep uneven grades, the tramming of ore on the Pennsylvania level had been carefully organized. Tramming methods had been evolved to get loaded from chutes and brought to the surface the 700 tons per day with a crew of four men on each of two shifts. Equipment consisted of two 4-ton, 18-in. track gage, 250-volt direct-current trolley locomotives, and thirty 3-ton center-splitting swivel-truck cars. The contract motor men spotted for the car dumpers.

Table I—Pennsylvania Tramming Analysis
March, 1927, to August, 1927 (inclusive)

	Total	Per Ton
Loading and motormen: Contract labor	$11,334.05	$0.1189
Chute blasting: Labor	2,457.00	0.0258
Ammunition	920.46	0.0097
Track maintenance, lighting: Labor-trackman	910.00	0.0095
Supplies	1,368.14	0.0143
Car maintenance (Includes shop labor and supplies).	2,123.57	0.0223
Motor maintenance (Includes shop labor and supplies).	2,510.89	0.0263
Power (Includes maintenance power and water lines, supplies, operators, purchased power	429.87	0.0045
Dumpers	4,368.00	0.0458
Totals	$26,421.48	$0.2771

	Tons
Tonnage: Unsorted ore	93,628
Waste not included above	1,716
Total	95,344

Distance trammed, 6,600 ft.
Conditions: Good, first three months; high water, second three months.

Level 13—Motor Sublevel Haulage
March, 1927, to August, 1927 (inclusive)

Charge	Total	Per Ton
Contract labor	$6,541.90	$0.1898
Chute blasting	781.98	0.0227
Motor repairs	913.92	0.0265
Car repairs	787.83	0.0229
Power	143.28	0.0042
General tramming overhead	502.56	0.0146
Totals	$9,671.47	$0.2805

Total tonnage	34,475 tons
Average distance trammed	884.33 ft.

Contract labor includes car dumping.
Equipment: 2 5-ton Jeffery-trolley locomotive and 3-ton swivel truck center-splitting cars.

In considering the costs one should note that chute blasting, commonly charged to mining, is under tramming, because it could not be segregated from the sublevel haulages. Car repairs are generally high because of the use of the old Smuggler center-splitting type of car, which requires a great deal of repair. Motor repairs are also high, because during the wet season the water is often up into the motor cases on the levels. The analyses of costs of tramming on various levels at that time indicate that the Pennsylvania costs were in line with those for the rest of the mine, when the long haul and difficult conditions are considered.

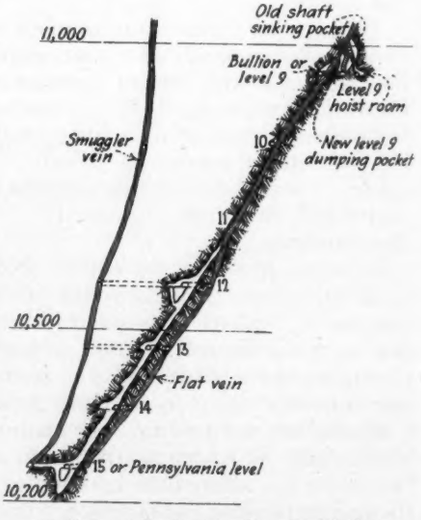
Level 8—Hand-Tramming Contract
March, 1927, to August, 1927 (inclusive)

Charge	Total	Per Ton
Contract labor	$3,496.47	$0.2145
Ammunition	475.17	0.0291
Car repairs and supplies	372.56	0.0229
General tramming overhead	237.66	0.0146
Nipper labor	130.65	0.0080
Totals	$4,712.51	$0.2891

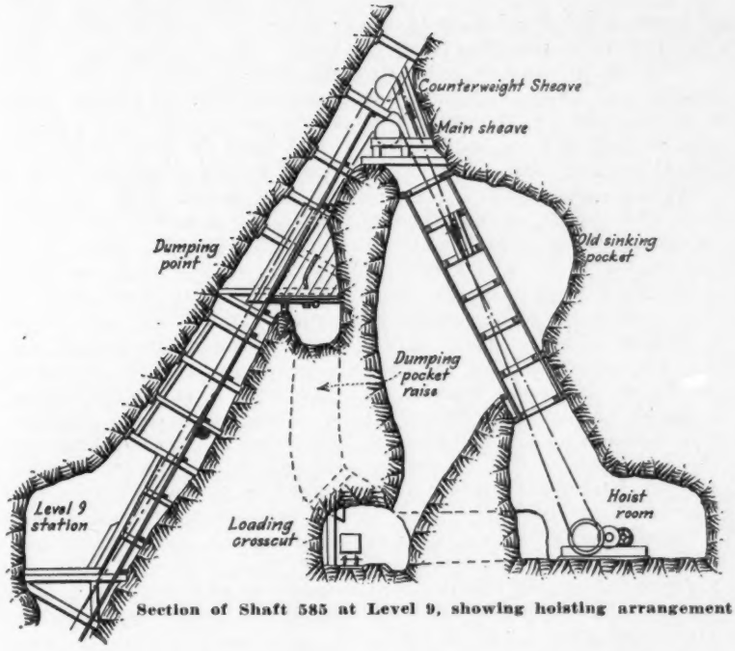
Total tonnage	16,301 tons
Average distance trammed	282.56 ft.

Contractors took care of chute blasting.

The method of organization of Pennsylvania tramming was as follows: In the mine, ore from below the Bullion Level (No. 9) and above the Pennsylvania Level (No. 15) was dropped



Section of Shaft 585 after completion of its construction



Section of Shaft 585 at Level 9, showing hoisting arrangement

through ore passes to the Pennsylvania Level and there drawn through chutes to the tunnel cars. At points on Level 15, where the vein was narrow, to avoid congestion on the main level, all stoping was done from a sublevel above a pillar, 12 to 15 ft. thick, over the main level. The ore from these stopes was dumped in main chutes usually 300 to 500 ft. apart, from which it was drawn on the main level. On the wide or Combination vein the grizzly chambers described by Mr. Livermore were used, the ore being broken to size for drawing at the grizzlies, and then drawn out through chutes on the main level.

These descriptions and the analyses indicate that the mine had been well organized for the production of a heavy tonnage from the Pennsylvania Level. Exhaustion of the ore reserves above the Bullion Level showed that the life of the upper mine was short, and that all the ore would soon have to come from below. Accordingly, ideas were assembled for the building of a second Pennsylvania unit at the side of the first, with moving grizzlies for the picking of the ore, in place of the sorting tables, and a large unit for the primary crushing of the rock. These could not be bought at the time of building the plant in 1925, because of the need to use material almost all of which was on hand at various places on the property at that time. By their installation a speeding up of the plant was expected and a considerable cut in labor costs would result. Rotary dumps, similar to those in use at the Bullion, were to be installed, and solid-body cars used, which would have cut the car-repair costs on this level materially. In the next year the Bullion surface plant would have come to handle little ore, and the more efficient Pennsylvania plant would have cut the costs still further from those already attained.

All of these plans were set at naught by the burning of the plant. The construction of a new one would have been a winter's work, with attendant high costs already experienced in the building of the previous plant, when, because of a hard winter, much of the work was only accomplished by men fastened by ropes working for short periods in 10 to 20 deg. below zero on the icy cliff. This plant would have taken until spring to build. In the meantime, the mine and mill force would have been scattered because the mine and mill would have been closed for lack of ore. The general heavy overhead would have had to be burdened in the meantime with a heavy construction cost. An alternative was to arrange means of bringing the ore from below to the Bullion level and sending it through this plant. Internal Shaft 585 was already equipped with a small hoist and man cage, used for lowering and hoisting men and supplies to and from the Bullion Level. This shaft, on the vein, with its attendant changes of dip, consisted of (1) a manway 3x3 ft., on the south side to Level 13 and on the north side below this level; (2) a main hoisting compartment 3x5 ft. in the clear—the 3 ft. dimension being above the track and the 5 ft. dimension lengthwise of the shaft; and (3) a counterweight compartment of small dimensions, not completed except for a small distance below Level 9, which compartment was on the north side of the main compartment. A large pocket had been constructed under the shaft above Level 9, used when sinking the shaft. At the time the decision was made to use this shaft, the idea was to use the pocket as well, but a final check showed that, after filling with old timber butts and waste around the timbered ropeway from the hoist room, this pocket had settled from the back and caved from Ore Pass 580, with many thousand tons of waste. The cost of using this pocket would have been excessive. After considering various other means of getting the ore to the Bullion, the decision was reached that the use of the shaft would be the quickest and least costly.

Accordingly, a check of material and equipment on hand was made. The engineers got together the details of the shaft above Level 9 for the change-over. A drawing was at hand of a skip built for the Black Bear shaft, and this was altered sufficiently to build a 40-cu.ft. skip for Shaft 585. The hoist had been used with a counterweight at the Humboldt shaft, and so the dividing flange for the drum was used, and a rope bought for the old Level 1 Smuggler hoist on Shaft 585 was put into service for the counterweight. Two sheaves were placed to bring the rope from the counterweight compartment into line with that section of the drum. The counterweight main sheave was set as high as possible in its compartment, to allow maximum clearance for the counterweight. The old main sheave was used as originally set for the main hoisting compartment. When it was found that the old sinking pocket could not be used for the new installation, a raise was carried through from Level 9 into the pillar between the shaft and old pocket, and into the shaft at the proper position for the dumping pocket. This was done without damaging pillar or shaft for a total distance of 43.5 ft., in four days of three shifts each, including the setting of the chute in the loading crosscut on Level 9. This permitted the completion of the dumping pocket by the time the remainder of the work was ready. The dummy or counterweightway was cleared out and rails were laid.

Below Level 13 a timber-lined pocket

Surface plant at the Bullion tunnel adit

Level 12 station, showing skip and counterweight

was built in a large place in the shaft, with clearance only for the counterweight and main skip, and with a chute to a measuring hopper over the main skipway. The measuring chute was equipped with heavy toggle latching doors, so that a full-skip load could be dropped in at the instant of spotting the skip, to speed shaft operation. A chute was placed on Orepass 586 at Level 13, so that ore from Level 12 might be taken at Level 13, and hoisting for both levels done from there. A skip-changing station was placed at Level 14 station, not in use at this time. This "garage," as it was called, enabled us to change from skip to cage, or *vice versa*, in three to five minutes with one skip tender.

A special safety hook was used on the hoisting rope. In the meantime a skip and counterweight had been built in the Bullion shops. An old operation with much material that had gone out of use on other work was handy when it came to this rush construction, because with slight alteration much equipment served for other uses. From experience in the Black Bear shaft, both the skip and counterweight were made with swinging rear axles, which provided three-point support and kept them on the track in the shaft. This construction had all been completed by Nov. 9, and hoisting from Level 13, bringing ore from Levels 12 and 13, was commenced on that day. Ore was thus being hoisted the nineteenth day after the fire. Mining or development or handling of supplies had not been interfered with in the lower levels.

The method used in maintaining production from the mine during the period of getting in the ore from Levels 12 and 13 was to speed up everything above. The broken ore of the mine at the time of the fire was distributed as 22,000 tons above Level 9 and 51,000 tons below Level 9. As the broken ore above Level 9 did not constitute one month's draw under the former rate of from 27,000 to 30,000 tons mine run per month—and some of this was in stopes at this time in the process of mining—the difficulty of maintaining production is easily seen. The extra men from such stopes below as became filled up were placed immediately to forcing the upper-level stopes, and tramming was raised to the maximum from the stopes which could be drawn. Men from the Pennsylvania plant were placed in the Bullion plant to speed up the sorting. The result was that the mine tonnage to the mill was held up to 21,718 during October, and fell off to 15,000 in November because there was only the small skip to rely on for the main tonnage, but the lower levels raised the grade of the ore.

The hoisting plant, as arranged at this time, was to handle sufficient ore to keep the mine going until a larger hoist could be bought and built to fit the work of hoisting from below Level 13. Also, a larger skip and pockets at Levels 12 and 15 had to be constructed and some necessary changes made in Level 15 station and shaft to accommodate hoisting from that point. The small plant was successful in this, as shown by the 9,932 tons hoisted from Level 13 in December, 1927. In the meantime, designs were being drawn and plans made for the main installation. Because the shaft was so poor, the hoisting speed had to be limited to 500 ft. per minute. The power charges in this district are based on peak load, so a hoist using a counterweight balancing the skip and half the load was decided upon. Clearances at the dumping point, unobtainable without damaging the pillar under the shaft, would not allow a longer skip than the 70-cu.ft. capacity one finally chosen, easily cut from sheet carried in stock. From experience with our 40-cu.ft. skip, a method of stiffening the lower side, where the rock hit from the loading chutes, was evolved, light yet strong. The skip was heavier than would have been necessary in a square shaft or a vertical one, because of the impact of large rocks against this lower side.

No crushing arrangements were provided underground, and Smuggler standard chutes permit the passage of large rocks, which cannot altogether be stopped by grizzly bars set to an opening large enough to get through the necessary tonnage at the pockets. This skip was equipped with center-hinge rear axle and roller-bearing wheels. The front wheels were carried on spiders, so that the skip might be as large in cross-section as possible, bolted into the skip to permit quick changing for repair. A single set of these roller-bearing wheels with chilled treads lasted the remainder of the mine operation—nine months. Liners were bolted into the skip. The lower side liner plate carried 4-in. tee-iron stiffeners riveted to it. This riveting could be done in the shop, as extra liners were kept on hand and thus the change in the mine was a short job between shifts.

To make the installation flexible—so that if repairs to the large skip were to be made which would cut it out of service for a period, the 40-cu.ft. skip might be brought into use without making major changes on the hoist—the counterweight was arranged with a trailer carried on two wheels and fastened to the main weight by a center hinge pin, so that the extra weight to work with the large skip might easily be swung off or on. A center hinge pin fastening gave the same three-point support to this trailer that had been carried out on the skip, and no trouble was experienced with the weight jumping the track. The weight and trailer were both built up from cast-iron weights from an old pattern at the local foundry, and the weights were set in a well-braced angle-iron frame. No major repairs were necessary that would take the large skip out of service during the hoisting of the 138,873 tons hoisted after the installation of this skip, so that this flexibility was not required.

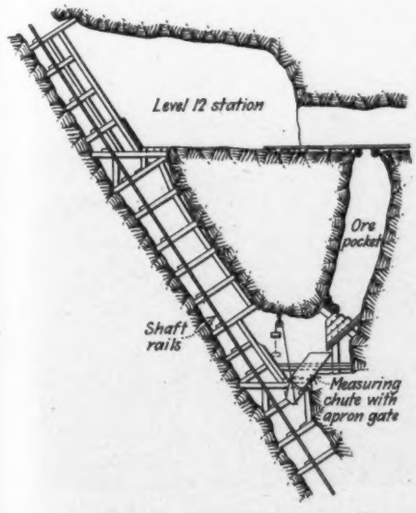
A hoist was chosen to fit the conditions. The ropeway from the hoist room to the shaft was a square timberway, carried up through the old pocket prior to the settling of the back and supported by the blocking and waste filling. Its removal, to carry the rope from the hoist with proper drum widths for a minimum of layers, would have been difficult while continuing the operation of the old hoist, which continuation was necessary to maintain tonnage. The skip being heavy, and the counterweight being built to balance the skip and one half the load, the total pull on the drum and drum shaft was 15,000 lb. Heavy ribbed castings comprised the drum, with the divider cast integral with the center cylindrical portion. The largest piece, 5 ft. 2 in. diameter, would, with a little trimming, just pass some of the old timber in the mine. Power came from a 100-hp. wound rotor, 3-phase, 60-cycle, 400-volt, 900-r.p.m. induction hoist motor, with drum-type controller and extra-heavy rheostat. Hoisting speed was 500 ft. per minute, because of the conditions mentioned. A low speed resulted in a short acceleration period. The brake was of the post type, and the clutch of the band type. Space was available to set up the hoist at the side of the old hoist, which was in continuous operation.

The frame was carefully leveled, aligned, and riveted, and the hoist set up on blocks. Anchor bolts for the new hoist, just outside the frame of the old one, were drilled in and set while the old hoist was operating. When ready, the old hoist was dismantled and the new one shifted into its place. Time between cutting off shaft service until

the new hoist was grouted with quick-setting cement was 13½ hours. The new hoist, weighing 18,700 lb., was compact, permitting easy transfer along skid timbers. It was then turned over 31 hours after cutting off shaft service. Doubling up of ties in the shaft and changing of dumping guides at the pocket, going on during the change of hoist, was completed. With a loss of five regular mine shifts, operations were resumed in the shaft ready for the large skip. In the meantime the drawing had been increased so that little regular mine tonnage was lost.

Meanwhile a pocket with measuring chute had been constructed below the Level 12 as soon as the small skip was available to hoist the waste. Advantage was taken of an old small pump station, used when the shaft was sunk. This, at the right position for the loading station, was enlarged; and chute and measuring chute were set before starting to cut out the pocket under Level 12. This work was carried through with little interference with the shaft, which had been lined off with heavy timber. Shooting was carefully done with light charges. The section of Level 12 loading station illustrated herewith indicates the arrangement of the measuring chute and chute from the pocket. After completion of this pocket, the use of Raise 586 and the double handling of muck from Level 12 were discontinued.

Soon after starting to hoist ore from Level 13, the work at Station 15 was under way. The shaft extended only to Level 15, with no sump, and the station at this point was small—offering no opportunity for the movement of trains through it. It was enlarged and a side crosscut extended to the Flat vein, so that trains might be pushed through the north side of the station without interference with the handling of supplies in the station. Then the pocket was sunk as a small winze, to keep down the interference with other work. From the level of the loading station a crosscut was driven in line with the shaft, which was raised full size to Level 15. The shaft at Level 15 and below was enlarged to include a 3x4-ft. pump and ladder compartment on the north side, 3x3-ft. dummy compartment in the center, and 3x5-ft. main hoisting compartment on the south side. The shaft above Level 15 for about 30 ft. was squared up to line; the cage had previously come into this level with a steeper pitch than the general shaft. While the shaft to the pocket was being timbered up, the station timbers were being set, and the floor was being completed, the shaft below the pocket level was sunk to the sump level. This made the final depth of the shaft below Level 15 on the slope 57 ft. The timbering of the shaft was extended to the sump, the pocket station enlarged, and the pocket chute and measuring chute were set. Then the winze was enlarged by breaking into this chute until the pocket had a capacity of slightly over 100 tons without mucking back. This construction was the heaviest encountered in the whole change-over, because the ground below the Level 15 in the shaft was much disintegrated from faulting. The shaft is between the Flat and Smuggler veins and close to their junction point at Level 15. Considerable water was also found during sinking, which required continuous pumping—done by the regular Smuggler crew, who were inexperienced in sinking, which is not ordinarily required in the operation of the mine. The work was done with a minimum of expense, however, although slowly, because of handicaps. Financial conditions restricted increase in expense for the mine for any given month.



Section of Shaft 585 at Level 12 loading station

The accompanying sketches of sections of Shaft 585 show the positions of the works mentioned, but the scale is too small to give detail. Construction details around Level 9 may be seen in the section of the Level 9 hoisting plant. The section of Level 12 hoisting station and loading station will also serve for Level 15, the loading stations being nearly identical. Level 13 pocket was a makeshift to rush ore from this point, and so is not characteristic, and no view is shown.

A summary of the construction costs is given in Table II. In many items the costs of material are comparatively small, as in the counter-weight, where much old discarded channel and angle iron and several cast-iron weights were used from the scrap heap. The amounts include warehouse and general handling charge for material, all labor charges and other items that could be segregated. Had this work been carried alone, instead of as an incidental operation of the mine, the benefit of a costly crew used would have brought the overhead costs up to a much higher figure. At no time was this work allowed to interfere with the tonnage production from the mine.

Table II—Internal Shaft 585—Ore Hoisting Construction Costs Summary

Level 9 dumping pocket	$740.29
Counterweight	112.38
Counterweight trailer	256.82
Sheaves, rollers and rope	750.75
Shaft work	2,378.69
Level 13 pocket	1,314.48
Level 14 skip changing station	225.70
40 cu.ft. skip	529.42
Level 12 pocket	1,263.23
Level 9 hoist 585	4,736.63
70 cu.ft. skip	1,173.29
Level 15 work	9,965.82
Total	$23,447.50

Work was completed so that the hoisting of the waste in Pocket 15 was commenced March 1, 1928, and the hoisting of ore started the next day. A pump used in other parts of the mine kept the sump clear of water. This, driven by a motor using current from the trolley wire, was mounted on a truck which could be pulled above Station 15 with a winch in case of power failure. A small air hoist in the pocket station operated a small bucket, which could be dumped in the measuring chute, so that men could clean the sump from behind the timber without interfering with regular hoisting. Dams were placed across both connections from the station at Level 15 to the veins, and the track grade was raised over them to keep water from these drifts from running into the shaft. A catch basin caught the water under the shaft at Level 15 and diverted it so that the only water pumped was that made by the shaft below that point. Telephones connecting with the main mine telephone system were placed at each pocket. The electric-bell system had pull switches at each pocket, and the emergency bell on a low-voltage circuit could also be used for movement of the skip. The shaft was electric lighted throughout.

From the results attained with the installation the following analysis of the cost of hoisting was made. The period from May to September, 1928, was taken as average, because it includes equal portions of the wet period, when everything is difficult, and the dryer period, when everything runs smoothly. The costs include the total operation of hoisting ore, lowering timber, supplies, steel, and powder, and raising and lowering men. Details are in Table III.

With the ore not too coarse and not too sticky, round trips are made as follows: Level 12—536 ft., 2 min. 20 sec.; Level 13—675 ft., 3 min. 7 sec.; Level 15—910 ft., 4 min. 5 sec.

Because of the longer hoist from Level 15, considerable ore had to be maintained on Levels 12 and 13. This required the forcing of development on these levels. As the ore under the new methods of handling would have to be

Table III—Cost of Hoisting

Tonnage hoisted:		
May, 1928		16,710
June		13,241
July		14,840
August		14,986
September		11,744
Total		71,521
Average distance hoisted		
Level 12	13,529 tons x 536 ft...	7,251,544 ton-ft.
Level 13	13,105 tons x 675 ft...	8,845,875 ton-ft.
Level 15	44,887 tons x 910 ft...	40,847,170 ton-ft.
Totals	71,521 tons	56,944,589 ton-ft.

Average distance on slope, 796.19 ft.
Average inclination of shaft, about 58 deg. with the horizontal.

Operation:		
		Per Ton
Cagers and skip tenders, 466½ shifts@$6.946	$3,243.13	$0.0453
Hoistmen, 456.25 shifts @ $5.32	2,428.39	0.0340
Power	926.80	0.0130
Supplies—		
Oil, grease, cable dope	87.10	0.0012
Total operation	$6,685.42	$0.0935
Repairs:		Per Ton
Labor, carpenters and shaft men	$1,544.00	$0.0216
Labor, shop	1,233.90	0.0172
Supplies	1,237.74	0.0173
Total repairs	$4,015.14	$0.0561
Total hoisting	10,700.56	0.1496

higher in grade, every effort was made to reach the known oreshoot areas during the period of pulling the large stopes to the north of the shaft of Level 15. Previous to the fire, the stope north of Manway 712 on Level 15 was mined on the basis of fast mining and rapid drawing thereafter. Because of stopping of drawing on this stope for five months after the fire, the walls had a chance to settle, causing excessive dilution of the ore for hoisting and lowering the grade of this ore. As 22,000 tons of the broken reserve was at Level 15 in this stope, the effect on the mill heads can readily be seen. Some much higher-grade ore to balance this was therefore doubly necessary. At the same time, the levels below had not been opened on the basis of production through the shaft, but rather on production to the Pennsylvania tunnel plant. As a result, stopes to the south, not high grade when sampled, could not be carried up; and likely places, because of the cost of bringing the ore up heavy grades to the shaft, could not be started.

When barren vein matter came to the Pennsylvania plant it could be easily rejected as large pieces; but the Bullion plant was not so well equipped to handle large rock, and much of it, in the forced-sorting period, went to the mill ore bin. Because of this, ore as mined had to be of a safely higher grade. The ore as developed on the Smuggler vein south of the shaft in the oreshoots of levels above Level 15 and north of Shaft 26 was of sufficient grade, but narrow. The Flat vein, however, did not show up so well, and the Combination vein north of the Jump-Off Dike came into a broken zone. Here, the ore streak was not well defined. These two veins are the tonnage producers of the mine because each foot of development produces so much more ore that is more cheaply mined than in the Smuggler vein. Though tramming was organized to go to the outside, development of ore near the mouth of the Pennsylvania Tunnel was expected to help to maintain production at the old high figure, but this could not be attempted because of the high cost of tramming to the shaft up several heavy grades.

In the late summer, because of these conditions and the fact that the cost of recovery inhibited the removal of ore blocks in other parts of the mine, the impossibility was realized of furnishing the necessary large tonnage to the mill required to cover the heavy overhead of operations. Every cost had been pared down to a minimum, but the overhead of the tremendous plant, with its necessary ramifications, could not be covered by a small tonnage and leave profit. This caused the decision to be made to mine the better-grade ore and close the mine, no reserve being available to make a complete change-over of mine and mill and to do the necessary heavy development required to operate as an entirely different type of enterprise.

After the heavy work of the previous winter, this was rather a blow, but the organization worked loyally to complete the work of closing. The stopes of the lower Smuggler levels south, and one new stope of South 9 Flat vein, were rushed to completion, and mining finally shut down on the stopes on Oct. 20, 1928. Drawing was then maintained at as high a rate as possible, being organized so that the lower levels would be empty as nearly as possible at the same time, so as to maintain constant tonnage to the shaft, and also be drawn out before the small remaining tonnage of the Level 9 should be drawn. This worked so well that a constant tonnage was maintained up to the last tramway shift, and only 15 tons available tonnage remained in stope South 9. Too much cannot be said for the loyalty of the crew, who stayed in such a necessarily difficult period, knowing that they could only work a short time at the most. After closing, two days with a small crew were spent in removing motors, which would have been ruined by the dampness of the mine after shutting down. The last tonnage was sent over the tramway on Dec. 4, 1928, and the remainder of the crew left the hill on Dec. 6, 1298.

The closing of this old mine was really the result of a series of misfortunes. The disastrous fires which, at various times since 1918, had taken the Upper Adit buildings, the first Pennsylvania plant, the second Pennsylvania plant, the Pandora mill, and the Flotation mill, with the lower price of the metals and the lower grade of the ore in the lower south Flat vein, had all worked to set at naught painstaking thought and careful management. The mine had been kept alive and paid off a considerable debt during many years, through the energy, perseverance, and careful judgment of Mr. Robert Livermore, president and general manager of the company. Although ore of an average grade of $4.50 per ton net, in gold, silver, and lead, could have been mined at a good profit during the last year of operation — because of the economies which had been effected, and provided the tonnage could have been maintained at the same average as was carried through that year—the developments did not show that such tonnage would be available. The disasters had brought the reserve to so low a level that it could not be brought back sufficiently to carry through the necessary prospect development, and the closing of the mine resulted.

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In mining carbonados in Bahia, Brazil, giants are used to sluice the overburden from the beds of prehistoric rivers

Manganese in Electrolytic Zinc Practice

Oliver C. Ralston

Director of Research,
United Verde Copper Company,
Clarkdale, Ariz.

AN analysis of available data and a critical study of the available evidence that formed a considerable part of the testimony in the case of Electrolytic Zinc Process vs. French's Complex Ore Reduction, hinging on the validity of a Canadian patent granted to A. G. French, of Nelson, B. C., in 1912. Mr. Ralston's study will be concluded in subsequent issues.

NO ADEQUATE DISCUSSION has appeared in the technical press in connection with the litigation in the Exchequer Court of Canada, and later in the Supreme Court of Canada, regarding what has been known as the French process. As much technical information appears in the court record, and as the prior art was well established by the successful impeachment, by the Electrolytic Zinc Process Company, of one of the Canadian patents of A. G. French, a discussion of what came to light in that trial should be of interest.

Electrolytic Zinc Process Company, a holding company organized to acquire and administer the electrolytic zinc patents taken out by the Anaconda Copper Mining Company, the Consolidated Mining & Smelting Company of Canada, and the Electrolytic Zinc Company of Australasia, brought an impeachment suit in the Exchequer Court of Canada on Dec. 19, 1924, against Canadian Patent No. 140,402, of 1912, taken out by Andrew Gordon French, of Nelson, B. C., and assigned to the French's Complex Ore Reduction Company of Canada. The suit was tried, beginning Feb. 8, 1927, before Justice Audette in Montreal. His decision on March 4, 1927, ruled the patent null and void, on the ground that every substantial allegation in the defendant's patent had been anticipated and belonged to the prior art, and that the combination of steps used by the inventor was not of sufficient ingenuity to constitute true invention. Furthermore, the patent, having run fifteen years without being put into practical operation, was void for lack of utility. The patent really strove to claim the results of a process instead of the process itself.

The case was appealed to the Supreme Court of Canada, which court rendered a decision in the fall of 1929, written by Justice Rinfret, upholding the decision of the lower court and also pointing out that the description of the invention was so obscure as to be in doubt. Purification of zinc sulphate solutions was well established as a necessary part of the electrolytic process, and the absence of any reference to this step in the specification was interpreted as omission wilfully made for the purpose of misleading. Even though not wilfully obscure or misleading, the patent would be bad because it was so negligently and unskillfully drawn.

The prior art, as developed in the testimony taken, covers most of the important points of present practice. Therefore the patents of the plaintiff company are revealed in the light merely of improvement patents over the prior art, not basic patents. They cover preferred but not necessary details. Incidentally, most of them cover improved methods of purifying zinc sulphate solutions preparatory to electrolysis. The points in the prior art that were well established can be summarized as follows:

1. Roasting of complex sulphide ores to prepare them for leaching and electrolysis may be traced back as far as 1881 to Letrange.

2. Cyclic leaching and electrolysis with sulphate solutions started at least as far back as Letrange.

3. Purification of solutions, such as is practiced in lithopone plants, well known and described by Letrange, gradually received greater emphasis from subsequent experimenters. Present-day purification methods, the most intensive and effective of all, are still relatively unsatisfactory.

4. The presence of manganese in the zinc sulphate solutions was reported by Ashcroft and by Cowper-Coles in 1896-98, by Englehardt and by Laszczynski in 1906-10, all of whom observed that it was deposited as manganese dioxide on the anodes.

5. Electrolysis of solutions of zinc sulphate containing manganese was performed by all these experimenters.

6. Lead anodes were used by Letrange.

7. Aluminum cathodes were used by Cowper-Coles and others.

8. Open electrolytic cells without diaphragms were used by Letrange.

9. The use of zinc dust for purification of zinc sulphate solutions originated with Nahnsen, about 1894.

Obviously, the real occasion for impeachment of the A. G. French Canadian patent came from the continued assertion by the French's Complex Ore Company that the use of zinc sulphate solutions containing manganese in electrolysis was the invention of French and was being infringed by Consolidated Mining & Smelting in Canada, by Anaconda and others in the United States, and in other countries in which French had taken out patents. Suit for infringement in Canada had already been brought by the French company against Consolidated. The time to impeach the patent seemed opportune. The nearest corresponding United States patents are 1,055,157 and 1,055,158, of March 4, 1913, now expired, but much more restricted in their claims. In 1912 Consolidated Mining had made a contract with French to develop and use for one year a prior patent on roasting complex zinc ores. The contract involved a large cash consideration it an option to purchase were exercised, and it specified that future patents granted French in Canada should be included in the sale. The French organization has continually accused Consolidated of bad faith in dropping its option and proceeding with the development of an electrolytic process of its

own, after having had the benefit of instruction by the experts of the French organization, and it contends that the turning point from failure to success came through the work of A. G. French.

Of the terms of the French patent in suit, the following summary is herewith presented: It purports to be an invention for the treatment of complex sulphide ores containing zinc and manganese. The ore can be calcined by any process, but preferably by a previously patented process belonging to French, in which sodium bisulphate is added to the calcine toward the end of roasting. The calcine is to be leached to produce a solution containing zinc sulphate and manganese sulphate, and then electrolyzed, with the production of good reguline zinc and an anode deposit of manganese dioxide—a valuable byproduct. Some important details of electrolysis are specified and also included in the claims:

1. Solution should be near saturation if possible, preferably 1.25 to 1.30 in specific gravity. It should not fall below 1.20 during electrolysis.

2. The acid concentration should not rise above 2 per cent during electrolysis and before returned to leach more zinc.

3. The minimum potential across a cell should be 4 volts.

4. The ratio of manganese to zinc might be as high as ¾ to 1. No lower limit on manganese was set.

This method of operation was claimed to possess the following good features: (a) A constant deposit of reguline zinc—an effect ascribed to the presence of manganese; (b) the manganous sulphate in the solution prevents anodic polarization by free oxygen; (c) protection of the lead anode against corrosion, owing to the covering of the anode by the precipitated manganese dioxide; (d) the manganese is recovered as a product of commercial value.

In French's patent specifications the presence of manganese in the zinc sulphate solutions is assumed; the patent is for treatment of zinc ores containing manganese. The French company tried to interpret the patent as extending to zinc ores where manganese is added to the charge or to the solutions in order to obtain other advantages. Incidentally, few zinc ores are known in which the manganese content is not so high that it does not manifest itself by certain color changes in the solutions. Therefore, the patent, if valid, would cover almost all modern practice. The French company tried to point out that, previous to its time, manganese had been regarded as a detriment in the solutions, whereas A. G. French had proved it to be of benefit. On this fact rested the company's claim to patentability. The enumerated advantages from the presence of manganese, however, do not include the actual reason why it is tolerated or deliberately added in modern practice. Manganese, in one of its higher-valent forms, is added during the leaching cycle shortly before the final neutralization of the acid by zinc oxide or limestone, to oxidize ferrous sulphate so that it can be hydrolyzed and removed from solution.

The oxidizing effects of the manganese compounds also convert arsenic and antimony to their higher stages of oxidation, in which they function as acid radicals and combine with ferric hydroxide to form insoluble arsenates and antimonates. Germanium compounds are also removed. This feature was not included nor claimed in the A. G. French patent specifications. His son, Thomas French, who had managed the affairs of the company, had performed considerable experimentation and learned the advantages of the oxidized forms of manganese in the leaching solutions. While at Trail, he commenced his first electrolysis to "condition" solutions, which he explained in court as the attempt to convert some of the manganous sulphate of the solution into manganic sulphate, in order to attain proper purification during the next leaching cycle. Personal experience has taught me that manganese-bearing zinc-sulphate solutions contain very little manganic sulphate after electrolysis, but they do carry up to 0.015-0.020 gram manganese per liter as permanganate—a highly colored compound, which is continuously reacting with the manganous sulphate to precipitate manganese dioxide. Most of the oxidizing power of manganese in the depleted solution returned to leaching is derived from suspended particles of manganese dioxide. Although Thomas French's theory in regard to the exact form of manganese was wrong, he was correct in claiming the value of this solution in the leaching operation. However, this advantage is not claimed nor suggested by French.

His specification No. 1—to saturate the solution as nearly as possible, preferably keeping it at a specific gravity between 1.25 and 1.30—was shown to be contradictory. A saturated solution of zinc sulphate or of manganese sulphate has a specific gravity above 1.45 at ordinary temperatures. Present practice in the Anaconda and Trail plants is to use solutions of a specific gravity of 1.25, only slightly over half saturated.

The second specification—not to electrolyze until above 2 per cent of sulphuric acid—was a wise restriction in the time of the French patent application, 1912. Higher acidities had been attained by previous experimenters, but in some of the most important earlier work low acidity had been necessary, because corrosion of the zinc cathodes increases with the acid content. The presence of certain impurities in the solution greatly enhances the corrosive effect by lowering the potential at which hydrogen ions are discharged. Before the days of intensive purification the only cure for toxic impurities was to maintain a low acid content. Therefore, the specification to keep the acidity low by circulating the electrolyte over the ore more frequently, in line with the best experience of his predecessors, shows that French was working with impure solutions. E. A. Ashcroft had operated an unsuccessful pilot plant in much the same way at Cockle Creek, New South Wales, Australia, in 1897-98. He used coarse calcine, leached by percolation, circulating the electrolyte repeatedly through the beds. Manganese accumulated in the solution. Ashcroft regarded it as an undesirable constituent because the inevitable saturation would prevent the solution of zinc oxide. S. O. Cowper-Coles, operating at the same time in a pilot plant at Hayle, Cornwall, England, in 1895-99, specified that acid must be kept below one ounce per gallon (6.23 grams per liter). This electrolyte was likewise percolated through beds of calcine to insure a low acid content. No attempt was made to precipitate iron, although ferric hydrate was frequently seen on the surface of the filter beds. The solution was passed over scrap zinc and returned to the electrolytic cells. This removed the copper, but no attempt was made to remove manganese prior to electrolysis. French was not original in this specification. He merely followed precedent.

The third specification—to electrolyze with a minimum voltage of 4.0—is consistent with the use of a solution of low acidity. The conductivity of a neutral zinc sulphate solution is low. Over 4 volts is needed in order to force electric current through the solutions at any commercial current density. Modern practice, using less than 4 volts, involves a higher acidity and a more intensively purified solution, and thus gains the advantage of a higher conductivity. The preferred practice described by French was therefore reasonable in its day, but not consistent with modern methods.

The fourth specification—to use manganese in a ratio as high as ¾ Mn to 1 Zn and with no lower limit mentioned—covers almost the whole solubility range of manganous sulphate. French stated that good results could be obtained with 1 Mn to 8 Zn in the solutions—a concentration of manganese at times reached or exceeded in several modern plants. Electrolytic Zinc Process was therefore forced to disprove the advantages claimed by French.

Conflicting testimony was given in regard to the benefits at the cathode from the presence of manganese in the solution. The French experts claimed that manganese acted as an addition agent or "dope," leading to improved deposition of zinc. The experts for Electrolytic Zinc Process claimed that it was not beneficial, but innocuous, or a mild toxic agent.

William E. Harris, of England, testified to a commission authorized by the Court to take testimony in Europe that he had been in charge of the Llansamlet (Wales) test plant of the British Metals Extraction Company, during the period of its life, 1916-19, producing about one ton of zinc daily. Manganese, regarded as a necessity in the electrolysis, was added to the ore whenever the manganese content of the solution was low. The effect was to reduce corrosion due to impurities, especially cobalt, and hence it led to an increase in reguline zinc and more economical operation. Several tests were cited. In one, a solution containing 0.200 gram cobalt per liter was electrolyzed in a cell without manganese, and in a second cell the same solution with 0.193 per cent Mn was used. The current efficiencies over a seventeen-hour period with 28 amperes per square foot were 72 and 79.7 per cent, respectively, apparently proving manganese beneficial. Acidity ranged from 4 per cent at the beginning to 9 per cent at the end of the test. Neither of these current efficiencies is commercially acceptable. A solution with 0.200 gram cobalt per liter is never used in practice. To infer that manganese would confer the same benefit with less cobalt present is unfair.

Another test by Harris was described. "Works solution," known to contain manganese, was compared with synthesized pure zinc sulphate solution. In both cases 0.100 gram cobalt per liter was added. The current efficiency of the cell containing the works solution was about 80 per cent; that of the cell containing pure solution was only 74.3 per cent—another apparent proof of the benefit derived from manganese. For comment, one can say that if a pure zinc sulphate solution in a three-hour test, electrolyzed to 2 per cent acid only, gave an efficiency of only 74.4 per cent, this was clear evidence that the purity of the solution was not up to standard. An efficiency of 95 to 97 per cent should be expected. Cobalt alone is not a very toxic element. Both current efficiencies are low in comparison with that obtained from properly purified solutions. Furthermore, the statement that the presence of manganese, even with the higher acidity (8-10 per cent), would also be of benefit in properly purified solutions, can be made only by inference. The acidity was allowed to rise to only 2 per cent, a concentration that would have permitted 98 per cent current efficiency with a purified solution.

Experiments with manganese and cobalt, when electrolysis is permitted to proceed until these acidities are reached, were reported by H. Hey, whose testimony is given later, and shows the opposite effect. Therefore, if Harris' experiments should prove to be correct, and the French patent consequently upheld, its claims would have to be restricted to the low acidities and special conditions of which French knew and which he described in his specification, conditions so radically different from those obtaining in modern practice.

Finally, at the behest of the French group, Mr. Harris undertook to make a run with works solutions, carrying out the specifications of the French patent detailed in the foregoing, keeping the acidity below 2 per cent. He ran only seven hours at 22.5 amp. per square foot, obtained 98 per cent current efficiency, and felt sure he would have continued with this efficiency through a 48-hour run. In comment, it can be said that at low acidity such high current efficiency is to be expected, even with slightly impure solutions, especially for the first few hours of the run. As the cathodes grow thicker and rougher, the current efficiency always declines with increasing rapidity, because of the greater surface exposed to corrosion by the solution. The test is therefore inconclusive and might be unfair if accepted without comparison with longer runs.

The Court commission which went to Europe to take testimony for the trial also listened to Sherard Osborne Cowper-Coles, the inventor of the sherardizing process for protecting metals with a coating of zinc. In 1894 Coles had become interested in the complex sulphide problem at Broken Hill, New South Wales, and, with money supplied by the British Broken Hill Company, built a test plant at Hayle, in Cornwall. Calcine from zinc middling was placed in percolation vats and leached with cell acid containing only one ounce acid per gallon (6.23 grams per liter).

Coles placed his leaching vats and electrolytic cells in closed circuit, returning electrolyte to the leach as soon as the acid built up to the abovementioned low figure. The solution from the leach tanks ran through "epuration" tanks over scrap zinc to remove copper, then over an iron-carbon couple to remove the last traces of copper, and finally back into the cells. This was similar to the cycle proposed by French, with the exception that French left out purification entirely. No attempt was made to remove manganese before electrolysis and even iron was ignored. The low acidity of the electrolyte, due to the high rate of circulation, was the factor that permitted the electrodeposition of zinc without serious resolution. French was therefore anticipated by Coles in his use of low acidity and a rapidly circulated electrolyte and did not claim this in his patent, merely specifying it. The only difference between his practice and that of Coles in this respect was his specification that manganese *must* be present, whereas Coles had manganese present but regarded it as a harmless impurity.

A second expert testifying for the French group was Charles S. Witherell, of New York, who had been retained to make comparative electrolytic tests in the laboratory of Columbia University, on two solutions, one containing manganese, the other being free of manganese. Witherell's first test was on zinc sulphate solution, made up from roasted zinc ore. This solution was given a preliminary electrolysis with a fresh lead anode, throwing most of the manganese out of solution and depositing most of the zinc at the cathode, thus making a solution low in manganese. The zinc cathodes were redissolved in the acid electrolyte, restoring it to its original zinc analysis. Not all of it redissolved. A sludge of metal remained that probably contained some of the original impurities. To half of the solution manganous sulphate was added, to give a manganese concentration of 10 grams per liter. The two solutions were then electrolyzed in beaker-size cells, each having two sheet-lead anodes and one sheet-zinc cathode spaced 1.25 in. apart. The current density was 22 amp. per square foot. Both tests were started at 80 grams Zn per liter with 5 grams free acid. A tabulation of the current efficiencies after various intervals follows:

Time, Hours	Current Efficiency, Per Cent Solution With Mn	Solution Without Mn
7.5	97.5	99.3
22.5	71.9	65.8
Last 7 of 22.5	29.6	2.4

The apparent result of these tests was that during the first seven hours the cell without manganese did better work, but during the remaining time of the 22.5 hours' total the cell containing manganese did the better work. It developed, on cross examination, after rebuttal testimony by opposing experts, that, after about fifteen hours' run, one of the cells had a very low zinc content (the one without manganese). More of the zinc was plated out previously, and the solution during the last seven hours contained much more acid than zinc, so that practically no zinc deposited. Apparently this discredited the test.

Another point about Witherell's work, not brought out in the trial, is the preliminary removal of the manganese-dioxide sludge with such impurities as it may carry. In the past I have erroneously stated that this sludge would carry cobalt from the solution, but this was corrected at the trial. Cobalt is not precipitated with manganese dioxide in acid solutions, such precipitation taking place in neutral or alkaline solutions only. However, it is my experience that the sludge formed in the acid electrolyte carries out antimony from the solutions. If Witherell had antimony present in his original solutions, the preliminary electrolysis removed much of it in the anode mud. One of the most toxic of known impurities, germanium, is also to some extent precipitated with the mud. As pointed out in the foregoing, some of Witherell's impurities that went into the cathode were also left undissolved when he made up his final solution.

This did not make the test unfair as a comparison. Both solutions were made up in the same way, but he did not use unpurified solution as French did. To add manganous sulphate solution made up from C.P. material is also dangerous practice, because of the known nickel and cobalt contents of the usual C.P. manganous sulphate. This may explain the better current efficiency in the solutions without manganese during the first seven hours, the only period during which sufficient zinc was present to make the tests fair. Nickel, a very toxic impurity, was probably present. The experts of the opposing side pointed to this lower efficiency in the presence of manganese as evidence of its mildly toxic qualities, a conclusion that is not justified until the purity of Witherell's manganese sulphate is demonstrated.

In general, Witherell's tests were shown to prove the opposite of what he thought they had done, and that, furthermore, he had disregarded all the specifications and warnings of the French patent itself except that of having plenty of manganese present. His cathodes were reguline, but they were so honeycombed that those produced with as well as those produced without manganese were regarded as poor.

Thomas French, son of A. G. French, testified on the stand that the essence of his father's invention was to have manganese present in the solution, with the benefits enumerated earlier in this paper. He stated that the ordinary solution, if containing manganese and sodium bisulphate, as long as the acidity was kept below 3 per cent, would permit direct electrodeposition of good zinc without previous purification. However, purification of the solution with metallic zinc before electrolysis was advisable. His father had not resorted to purification, but he himself found purification advisable to some extent. As far as the patent is concerned, the inventor apparently failed to specify an important step. Only Thomas French was able to testify that some purification was not essential. All other witnesses thought it essential.

Harry Hey, chief metallurgist of the Electrolytic Zinc Company of Australasia, testified as an expert in behalf of the Electrolytic Zinc Process Company. The zinc sulphate solutions at Risdon, Tasmania, contained (at the time he testified) an average of 85-100 grams zinc, 12-14 grams manganese, and 0.080 gram cobalt per liter. Each cycle picks up 0.006 gram cobalt per liter from the ore, but operation is possible up to 0.080 gram. His evidence tended to show that manganese sulphate in the solution does not allow deposition of zinc in the presence of so much cobalt unless other means are taken to restrain the effects of the cobalt. At Risdon the principal procedure is the addition of glue to the solution. Antimony, down to 0.00025 gram per liter, must also be removed because a higher concentration gives a deposit of zinc that is rough, irregular, and nodular. My personal experience with antimony in the *absence* of cobalt is that up to 0.001 gram per liter can be allowed, and as much as 0.002 gram may be used before the ill effects become pronounced. Treating the neutral solution with a permanganate will precipitate all the manganous salt as manganese dioxide, carrying with it the cobalt.

Hey did not regard manganese in the solution as really injurious—only mildly toxic by itself. Neither did he think it beneficial, although he had operated with a concentration up to 20 grams per liter. The difference between the practice at Risdon and that of the French patents is that Risdon removes all toxic impurities except cobalt and leaves manganese to take care of itself. French did not remove toxic impurities, and hence had to operate at lower acid content, and, what is more important, he would not have been able to operate long with cobalt accumulating.

Addition of glue to reduce the ill effect of cobalt was not known nor used by French. Ashcroft's work at Cockle Creek must also have suffered from the effect of cobalt, although he did not know of its presence, and it was not discovered in Broken Hill ores until the experimental work that led to the erection of the Risdon plant in 1916. G. H. Clevenger then found it in purification residues and in solutions made from Broken Hill ores. Ashcroft and French simply had to operate with an acid content not exceeding 2 per cent, on account of their impure solutions, and the presence of manganese probably had little to do with the formation of reguline zinc. In fact, Hey said that some of the best and most reguline zinc he had made came from solutions free of manganese. He had found no toxic impurities the action of which was inhibited by the presence of manganese.

Several tables of figures and exhibition cathodes were submitted by Hey to prove that (1) a zinc sulphate solution containing no manganese and no cobalt gave excellent deposits and high current efficiency under conditions comparable to practice; (2) a solution containing cobalt but no manganese permitted good zinc deposits and fair current efficiencies; (3) a zinc sulphate solution containing both manganese and cobalt gave poor results; (4) a solution containing manganese, cobalt, and glue gave good results.

All of this was done under Risdon commercial conditions: namely, electrolyte at 35 deg. C., current density of 31.2 amp. per square foot, 3.69 volts per cell, and 72 hours' deposition before stripping. If manganese could be removed easily at Risdon, good deposition could be obtained in spite of the presence of cobalt, although the current efficiency drops from 95 per cent for pure solution to 93 per cent when 0.090 gram per liter cobalt, with sufficient glue, is present. Glue, and not manganese, is necessary. Manganese is not desired.

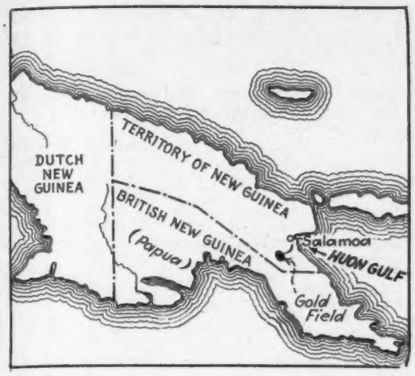
Hey stated that there is a maximum permissible quantity of cobalt in an electrolyte at any given acid content. With increasing acid content, the cobalt content must be decreased. French was forced to use low acidity, because a higher acidity was impracticable with his impure solutions. He may have had cobalt, and if at the same time antimony, arsenic, or copper had been present, his experiments would have been less successful. Manganese could not have helped to produce good cathodes.

Removal of manganous sulphate from solution by precipitation with permanganate, with resulting improvement in zinc deposition, at first caused the Risdon staff to believe that manganese in the solution was detrimental. Not until the cobalt was identified in the manganese precipitate did this idea lose ground. Cobalt, although undesirable, is not now considered highly toxic when alone. In the presence of manganese, however, its harmful effect is aggravated, although manganese, by itself, is innocuous.

Another witness, whose deposition was taken in London by the commission of the Court, was Stanislas Laszczynski, a Polish citizen. He had operated several test plants for producing electrolytic zinc in Vienna, and also in Miedzianka, Poland, between 1899 and 1910. He had also obtained patents—(see British Patent 1431 of 1910)—on electrolysis in a cell containing lead anodes wrapped with a fabric to prevent the electrolyte convecting manganese into contact with the anode, where it could be oxidized to the higher forms of manganese, such as permanganate. Presence of these higher forms of manganese on the cathode was stated to cause an attack on the zinc, producing holes that grew larger and larger until finally no zinc was deposited. See article by Walter Stoeger, *Oesterreichische Zeitschrift für Berg-und Hüttenwesen,* Jan. 2, 1909, Vol. 57. This behavior is characteristic of cobalt in solutions containing manganese, but Laszczynski, not knowing this, ascribed the trouble to manganese. His invention of preventing the formation of permanganates in the main body of the electrolyte was therefore faulty in theory although effective in practice. Had he removed cobalt he would have had no worry about the manganese, if Hey's experiments and my own experience are to be accepted. Manganous sulphate can hardly be credited with corroding power on metallic zinc. The evil effect must have come from the higher oxidized forms of manganese produced at the anode, and retained there when Laszczynski's fabric wrappings were used. This point in regard to the differing effects from the various forms of manganese was not mentioned at the trial.

(To be continued)

Air Transport of Dredges in New Guinea



Sketch map showing the situation of the New Guinea gold field

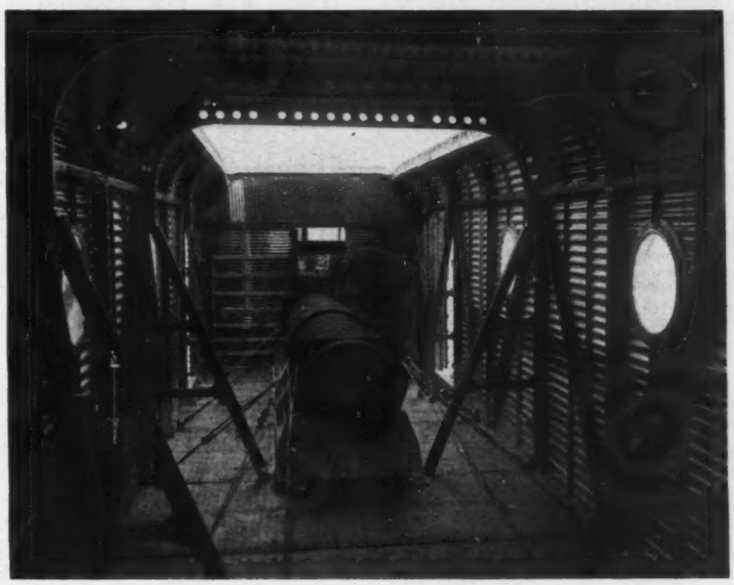
UNDER an agreement with Bulolo Gold Dredging, Ltd., which company is developing an extensive tract in the New Guinea gold fields for large-scale operations, Guinea Airways, Ltd., has established a direct 32½-mile airline between Salamoa, on the east coast of the island, and the settlement of Wau, at the gold fields. The line will be used primarily for transporting heavy mining equipment and supplies for the Bulolo company. It is considerably shorter than the circuitous route formerly employed, which started at Lae, north of Salamoa, and followed the Markham, Wamped, and Watut rivers. The new route, however, passes over a mountain range that reaches an altitude of 11,000 ft.

For more than two years Guinea Airways has operated an airline between the gold fields and the coast. Five Junkers Type W-34 airplanes have been employed, and trucks, tractors, and building materials, besides 500 lb. of mail and 1,000 lb. of beer per week, have been carried in by the line.

Three special Type G-31 Junkers airplanes will be used on the new direct line. The mining equipment to be transported, the total weight of which exceeds 6,500,000 lb., includes two steel-hulled, 10 cu.ft.-bucket dredges and a complete 1,100-kw. hydro-electric power plant. Although this equipment will, of course, be transported in comparatively small dismantled units, several pieces are of such weight and size that they made the selection of a suitable transport airplane of unusual importance. The crankshaft section of the dredge, for instance, weighs more than 7,000 lb. Such loads necessitate a fuselage structure sufficiently strong to sustain the resulting high pressures that these weights produce on the relatively small area over which they are distributed. Furthermore, the bulky units necessitated equipping the airplane with a large loading hatch.

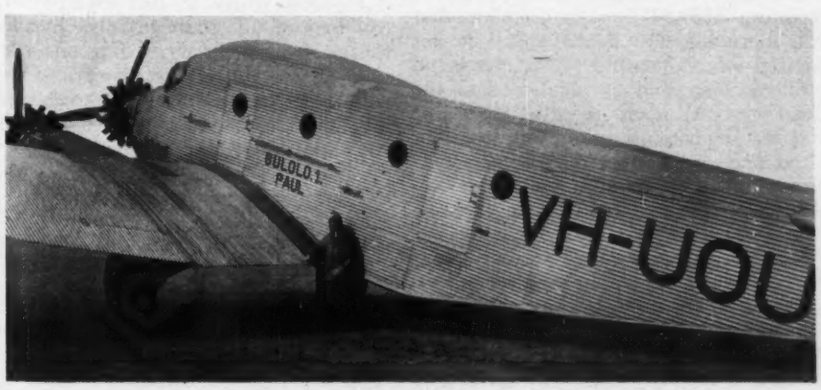
The Junkers Type G-31, after minor alterations of the fuselage, met the unusual specifications the requirements imposed. A trial flight was made last month, when the first of the three planes was completed. In this flight an iron model of the dredge crankshaft section, of the same weight as the original—about 7,000 lb.—was carried, as shown in one of the accompanying illustrations. With this weight, a crew of three persons, and fuel for an hour and a half, the airplane reached a height of 7,500 ft. in eleven minutes. Cutting out one side engine, it climbed 2,700 ft. to 3,150 ft. in 2 minutes. This performance, as described by the chief pilot and manager of Guinea Airways, who conducted the trial flight, surpassed the contract guarantees.

The three planes will be delivered during the current month and will be ready for service in New Guinea before the end of the year. Three 450-hp. air-cooled Bristol-Jupiter engines comprise the power plant of each plane, which will produce a full-load speed of 115 m.p.h. In the all-metal construction of the plane, duralumin and sheet steel are used for struts and for parts not exposed to particular stress; for pieces of unusual shape, electron and silumin are employed.



Interior of airplane, showing method of transporting dredge parts

One of the Junkers Type G-31 airplanes



Consumption of Flotation Reagents

THE trend toward the adoption of flotation is indicated by the increased tonnage and increased number of plants. Ores treated by flotation in 1928 totaled 59,064,385 tons, producing 3,696,423 tons of concentrates. Of this ore, 47,263,563 tons was copper ore. The total consumption of reagents was 264,033,473 lb., of which 208,249,403 lb. was lime. Consumption of reagents expressed in pounds per ton of ore was substantially the same in 1928 as in 1927, and the trends indicated are: (1) increased consumption of frothers; (2) decreased consumption of collectors; (3) more extensive use of alkaline circuits; (4) decreased consumption of sulphidizing reagents; (5) increased use of depressing reagents. Higher-grade concentrates were produced, indicating improved flotation practice. The data in the following tables were furnished by 208 plants, a survey that was 98 per cent complete.

Table I—Ores Treated and Concentrates Produced by 208 Plants

Ore Classification	Ore Treated in 1,000 Tons	Concentrate Produced in 1,000 Tons	Reagents Used in 1,000 Pounds
Making one concentrate:			
Copper ores (oxides and sulphides)	47,264	2,340	215,304
Lead ores (sulphides)	4,091	166	4,027
Lead ores (oxides)	44	11	
Copper-lead ores	417	39	1,644
Zinc ores	2,585	200	8,674
Miscellaneous ores	662	28	661
Making two concentrates:			
Lead-zinc ores	2,878	581	14,684
Copper-iron ores	377	41	15,521
Making three concentrates:			
Lead-zinc-iron ores	746	290	3,518
Total	59,064	3,696	264,033

Copper Ores—Twenty-seven operators reported the treatment of 47,263,563 tons of copper ore for 1928, from which 2,340,744 tons of concentrate was produced, showing a concentration of 20.2 to 1, compared with 15.4 to 1 for 1927. Although pine oil continued to be the most extensively used frothing agent, the increase in the amount of cresylic acid used was remarkable. Ethyl xanthates continued to be the most widely used collectors, but the use of the higher xanthates (amyl and butyl) declined considerably. Coal-tar creosotes were next in order of importance, followed by Aerofloat. More than 99 per cent of the copper ore was treated in alkaline circuits using lime, the consumption of which amounted to 4.197 lb. per ton of ore, compared with 4.004 lb. in 1927. Consumption of sodium sulphide showed a marked decrease, but an increase was reported in the consumption of cyanide, used in conjunction with lime as a pyrite depressant. Acid used in the selective flotation of copper-iron ores showed a large increase over 1927.

Lead Ores—The tonnage reported from 23 plants in 1928 was about 90 per cent above the figure for 1927, due almost entirely to the increased use of flotation in the Missouri lead district. Much more cresylic acid was consumed than pine oil, but it should be noted that the smaller quantity of pine oil was used in the treatment of a larger tonnage of ore. Consumption per ton of ore was 0.025 lb. for pine oils and 0.087 lb. for cresylic acid. Pine oil was used at seven plants in conjunction with cresylic acid. Ethyl xanthates were the most commonly used collecting reagents, followed in order by Aerofloat and wood-tar creosotes. In general, the consumption of frothers and collectors per ton of ore treated decreased, whereas the consumption of other reagents remained about the same. Sulphuric acid was used at two plants in the treatment of oxidized lead ore. In the treatment of copper-lead ore, large quantities of lime and sodium carbonate were used (3.576 lb. per ton). This class occupies an intermediate position between lead ore and copper ore, using less frothing and more collecting agents.

Zinc Ores—Reports from 100 plants treating 2,584,844 tons of ore show that the more difficultly floated sphalerite required larger quantities of frothers and collectors as well as alkalies than the lead ores. All plants reported the use of copper sulphate. Thirty plants treating lead-zinc ores reported a larger consumption of frothers as well as of collectors, compared with straight zinc ores, owing to the fact that two concentrates were made. The increased consumption of copper sulphate (compared with straight zinc ores) may be due to the difficulty of activating deadened sphalerite, but a large part of the increase is probably caused by the higher sphalerite content of the ores treated. Compared with 1927, no radical change in the use of depressing reagents was noted in 1928.

Treatment of complex lead-zinc-iron ore at three plants making three concentrates required even larger amounts of frothers and collectors. A smaller consumption of alkalies was reported. Of interest is the production of an iron concentrate without the use of acids in a circuit of low alkalinity.

Eighteen plants in 1928 treated 661,854 tons of miscellaneous ores in alkaline or neutral circuits. Pine oils were used almost entirely as frothers. Creosotes, petroleum products, water-gas oils, and ethyl xanthates were the most commonly used collectors.

Table II—Reagent Consumption in the Treatment of All Ores

	Reagents Used in 1,000 Pounds	Reagents Used Lb./Ton Ore
Pine oils	5,310	0.129
Cresylic acid	3,670	0.157
Anilin	3	0.375
Ortho-toluidin	47	0.041
Xylidin	12	0.036
Ethyl alcohol	3	0.375
Butyl alcohol	6	0.194
Total frothers	9,052	0.155
Coal-tar creosotes	2,252	0.303
Coal-tars	29	0.016
Wood-tar creosotes	412	0.073
Crude oils	7	0.013
Petroleum products	144	0.336
Blast furnace oils	141	0.013
Water-gas oils	33	0.783
Miscellaneous oils	3	0.105
Total collectors	3,021	0.128
Sulphurized pine oils	57	0.143
Eureka No. 70	9	0.184
Aerofloat	970	0.028
Total reconstructed oils	1,036	0.029
Ethyl xanthates	3,401	0.100
Amyl and butyl xanthates	242	0.063
Phosphorous penta sulphide	5	0.162
Thio carbanilid	170	0.045
Alpha-naphthalamine	9	0.051
Total chemicals	3,827	0.095
Sulphuric acid	12,441	29.511
Hydrochloric acid	1	0.002
Total acids	12,442	27.716
Sodium carbonate	5,708	0.551
Sodium hydroxide	2	0.024
Lime	208,249	3.909
Barium carbonate	1	0.096
Cement	1,896	4.426
Total alkalies	215,857	3.873
Sodium sulphide, for sulphidizing	2,399	0.329
Copper sulphate, for activiation	6,898	0.721
Cyanides	2,195	0.077
Sodium sulphite	404	0.636
Sodium silicate	3,655	0.981
Sodium dichromate	11	0.194
Sodium chloride	1	0.044
Trisodium phosphate	52	0.146
Calcium chloride	360	0.461
Zinc sulphate	2,820	0.423
Total depressing agents	9,500	0.287
Grand total	264,033	4.470

Abstracted from Report of Investigations No. 3004, U. S. Bureau of Mines, by T. H. Miller, assistant mineral economist, U. S. Bureau of Mines, Salt Lake City, and R. L. Kidd, ore-dressing engineer, University of Utah, Salt Lake City, Utah.

Kiirunavaara thirty years ago

Swedish Iron Ore: Mining and Transport

B. H. Strom
Assistant Editor

Lapland, bleak and desolate, has little to offer those to whom ease of life is essential. In this forbidding country, north of the Arctic Circle, Swedish mining has added another chapter to the tale of man's conquest of the earth. The din of steel drills and the roar of mighty blasts have roused the iron mountains from their slumber; cities have been built, rivers harnessed, and tracks stretched from coast to coast, bearing the treasures of the mountains to the sea.

NORTH of the Arctic Circle, at about 68 deg. latitude, are the iron deposits of Lapland, the largest in Sweden and among the greatest in the world. Ore is mined in two districts, Kiruna and Gällivare, about 60 miles apart. Gällivare, the older district, was worked on a small scale as early as the middle of the eighteenth century, when the ore was transported with reindeer to blast furnaces on the Gulf of Bothnia. Mining in Kiruna, however, dates back only about thirty years. The exact date of discovery is not known. Many outcrops were undoubtedly known to the Lapps centuries ago. Documentary evidence goes back to 1643, when the mine Junosuando was mentioned. Here the first blast furnace in Lapland was built in the middle of the seventeenth century. Difficulties of transportation and adverse climatic conditions were the chief obstacles to successful exploitation. Not until the early part of the present century, in 1902, after the completion of the railroad to the Norwegian port of Narvik, was development on a large scale made possible. Shipments, which in 1903 amounted to 800,000 tons, are estimated to exceed nine million tons in 1930.

Dr. Hjalmar Lundbohm, since deceased, who played a most prominent part in the development of the field, in 1910 made the following estimate of the known ore reserves:

	Million Tons
Kiirunavaara and Luossavaara	758
Gällivare Malmberg	230
Koskullskulle	40
Tuollovaara	7
Svappavaara (government property)	30
Leveaniemi (government property)	30
Ekströmberg (government property)	50
Mertainen (government property)	5
Ruoutevaara (government property)	8
Total	1,158

Later diamond drillings have demonstrated that the orebody at Kiirunavaara is of far greater extent than was formerly assumed. The reserves are probably close to 1,000 million tons, making the total for Lapland 1,500 million tons. With the present rate of shipment the deposits are assured a life of 150 to 200 years.

The ore is of a high quality, the iron content varying between 58 and 70 per cent, with a low sulphur content. Part of the ore is almost entirely free from phosphorus and is therefore well suited for manufacture of Swedish charcoal iron, but the major part has a high phosphorus content and is exported to the European Continent, where it is treated by the basic process.

Luossavaara - Kiirunavaara Aktiebolag, L.K.A.B., was formed in 1890 to exploit the iron deposits of Kiirunavaara and Luossavaara. In 1903 it was taken over by Trafikaktiebolaget Grängesberg-Oxelösund, a holding company which also owns the iron mines of Central Sweden and has control of about 2,000 million tons iron ore with a total iron content of at least 1,200 million tons. Grängesberg owns half of the company's stock—40,000 shares with a par value of 40 million crowns—and the other half is in the hands of the Swedish government. According to an agreement, the government has the right to buy the remaining shares on Dec. 31, 1936, at a price based on the earnings between 1922 and 1933. The chances for such a step, however, are remote. In 1903

Gällivare company was acquired by L.K.A.B. The deposits at Tuollovaara, 2½ miles from Kiruna, are operated by Tuollovaara Grufaktiebolag, founded in 1900 by nine iron works in Central Sweden. Eight claims on the east side of Malmberget, at Koskullskulle, are owned by the Witkowitz works in Mähren, Czechoslovakia, and are often referred to as the Czechoslovak mine. This is the only foreign interest in the field.

Kiirunavaara and Luossavaara, the two iron mountains, rising about 2,500 ft. above sea level and 800 ft. above the surrounding plateau, are about three miles apart, separated by lake Luossajärvi. Kiirunavaara is a ridge, about 2½ miles long, and Luossavaara a cone-shaped mountain. Outcrops of the ore may be seen in many places at the top of both mountains. The orebody following the crest of Kiirunavaara has an average width of over 300 ft. and a length of about 3½ miles. It dips 54 deg. to the southeast and continues under the lake. Diamond drilling down to 2,600 ft. below the surface of the lake has shown that the orebody is very deep. In Luossavaara it has a total length of over 4,000 ft. with a dip of 65 deg. Both deposits show many similarities and are unquestionably derived from the same orebody by faulting.

At Kiirunavaara open-pit mining by underhand stoping is used almost exclusively. Underground mining has, however, been started and will in course of time supplant the present method. Ingersoll-Rand piston and hammer drills are used, and hammer drills made by Atlas-Diesel, Stockholm. The compressors are furnished by Ingersoll-Rand and Atlas-Diesel, and the drill sharpeners by Atlas-Diesel. Holes are drilled to a depth of 21.3 ft. and enlarged by repeated blasting with small amounts of dynamite, using a Cordeau fuse. The largest pieces are blockholed before loading. This procedure permits charging as much as 440 lb. dynamite per hole. Blasting is done three times a day, at 8:40 a.m. and 12:20 and 4 o'clock p.m. Warning is given by blowing a siren and flying red flags in the blasting areas.

Loading ore in open pits, Kiirunavaara

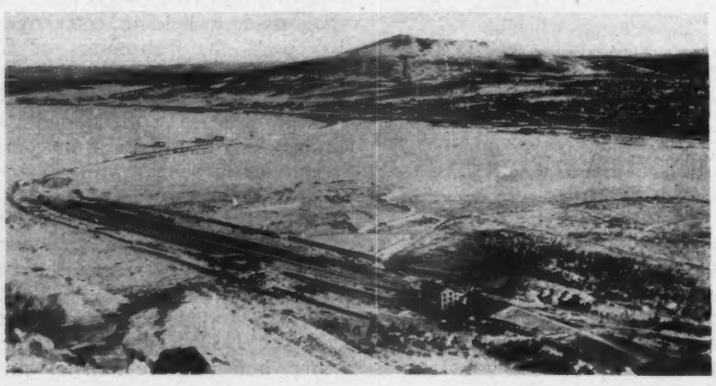
The holes are drilled both horizontally at the base of the bank and vertically downward from the top. Horizontal and vertical holes are also often drilled at intermediate points on the bank. In the edge holes the average charge of dynamite is about 100 lb.; in the bottom horizontal holes, 165 lb. Bank holes are shot with fuse. In the drill holes, as in the shaft, electric firing is used. Fifty per cent dynamite is employed, but experimental blasting has been done with 55 and 75 per cent dynamite and 91 per cent blasting gelatine. Each pound of dynamite yields an average of 5.18 tons of ore and 3.93 tons of barren rock, and each foot of hole drilled an average of 30.27 tons of ore and 28.8 tons of rock. Extraction of ore necessitates the mining of considerable waste—both from the footwall and the hanging wall at the different levels.

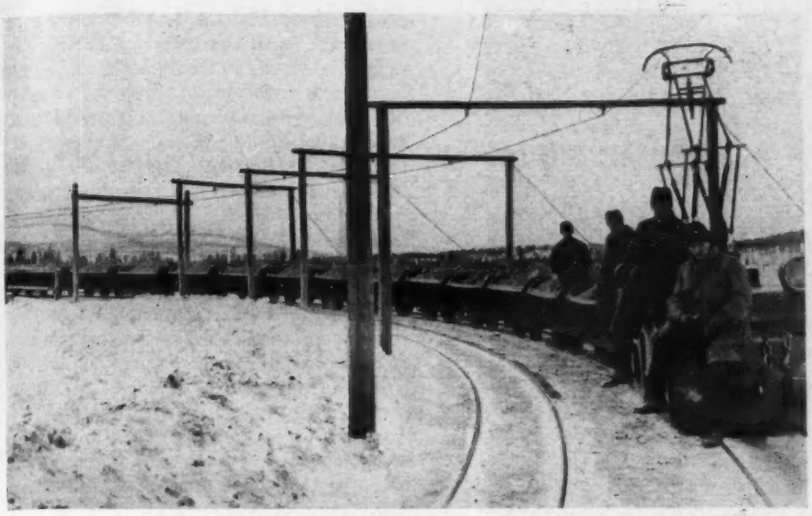
Eighteen electric shovels are used for loading the ore, each having a dipper capacity of 13.7 cu.yd., and equipped with SKF roller bearings. Under favorable conditions each shovel can handle over 2,000 tons per eight-hour shift, the average being 1,000 tons of ore and 600 to 700 tons of barren rock. Two of these shovels are of Swedish make, manufactured by Morgardshammars Mek. Verkstads A.B.; four are German, made by Menck & Hambrock G.M.B.H., Altona-Hamburg, and twelve are Bucyrus-Erie shovels. Each shovel is served by two electric locomotives.

The ore is loaded into flat-bottom cars of from 30 to 35 tons' capacity, equipped with SKF roller bearings. Five cars are pulled by each locomotive, which is driven by a 220-hp. d.c. motor. The locomotives are made by Siemens Schuckert, German A.E.G., and Allmänna Svenska Electriska A.B. The cars deliver the ore to crushers, which can reduce blocks weighing about 10 tons to 10 to 12 in. Five crushers are used, two from Morgardshammers Mek. Verkstads A.B., one from A. B. Bofors, and two from Power & Mining Machinery Corporation. These crushers are driven by 250-hp. motors.

The crushed ore is dumped into pockets measuring 13x13 ft., from which it is drawn directly into 35-ton railway cars, made into trains of twenty cars, hauled by electric locomotives. Ore mined in open pits is often mixed with some snow and has a tendency to freeze in these shafts. Different methods of dislodging the frozen ore are used, such as blasting with dynamite, which has several disadvantages; thawing with hot salt water; and injection of steam. The cars are weighed during the loading on a weighing bridge, with light and sound signals indicating a full load. Weighing bridges are furnished by Lindells Vagfabriks A.B., A. B. Stathmos, and Fairbanks, Morse & Company. This loading of the crushed ore is done in a tunnel, the "Lake Tunnel," which enters Kiirunavaara at the level of the lake, and extends for almost two miles into the mountain. Average loading time for a train of twenty cars is 15 min., or 45 sec. per car. After the cars are pulled out of the tunnel they are weighed and sampled, made into trains of 40 cars each, and turned over to the State Railway. About eighteen trains leave Kiruna daily for Narvik, 102 miles away, a total daily shipment of

Kiirunavaara today, after removal of almost 100 millions tons of ore





Ore trains are hauled from the mine to the concentrator by electric locomotive at Malmberget

about 25,000 tons. The cars weigh 11 tons when empty and have a net carrying capacity of 35 tons. Electric locomotives, furnished by Almänna Svenska and German A.E.G., 2,200-hp. capacity and 127 tons' net weight, are used. A running speed of 30 m.p.h. is adopted for the loaded trains and 36 m.p.h. for the empties.

Kiruna ore is known for its high quality, the iron content varying from 58 to 70 per cent, and sulphur being almost entirely absent. The greater part of the ore is a hard, compact magnetite, generally containing some apatite, either in veins or disseminated. Five classifications are made, A, B, C, D, and G, based on the phosphorus content and ranging as follows:

Class	Maximum Per Cent Phosphorus	Per Cent Iron
A	0.03–0.05	69–70
B	0.30	67–68
C	0.80	66
D	0.80–2.00	62
G	2.00–4.50	58

Class A ore is mined principally at Luossavaara and in the northern section of Kiirunavaara; B and C are mined also at Luossavaara and in the southern section of Kiirunavaara. The main orebody at Kiirunavaara, however, has a high content of phosphorus.

The reserves at Luossavaara above the level of the lake have been estimated at 22.5 million tons, only a fraction of those at Kiirunavaara. Much more attention has to be given to sorting of the ore at Luossavaara, and loading by hand shoveling is therefore employed. Ore cars of about three tons' capacity are used. These are dumped into a shaft, from which the ore is drawn into 5-ton side-dump cars, made by A.B. Lulea Varv & Verkstader, and hauled by electric locomotives through a tunnel driven 328 ft. below the top of the mountain, to an ore pocket immediately above a double-track incline. From this pocket the ore is discharged into cars of 20 to 25 tons' capacity, which are run down the incline to a 2,000-ton steel bin, where the ore is loaded into railroad cars. This loading station is connected with the main line with a spur 3 miles long.

Blasting and drilling are done in the same way as at Kiirunavaara. Compressed air is supplied by Atlas-Diesel and Nordberg compressors. Daily output of the mine is about 1,000 tons, all of which is shipped to Narvik. About 200 men, working on two shifts, are employed. Electric power is supplied from the central power station at 4,000 volts. A 300-kw. rotary converter delivers direct current to the electric locomotives at a tension of 600 volts.

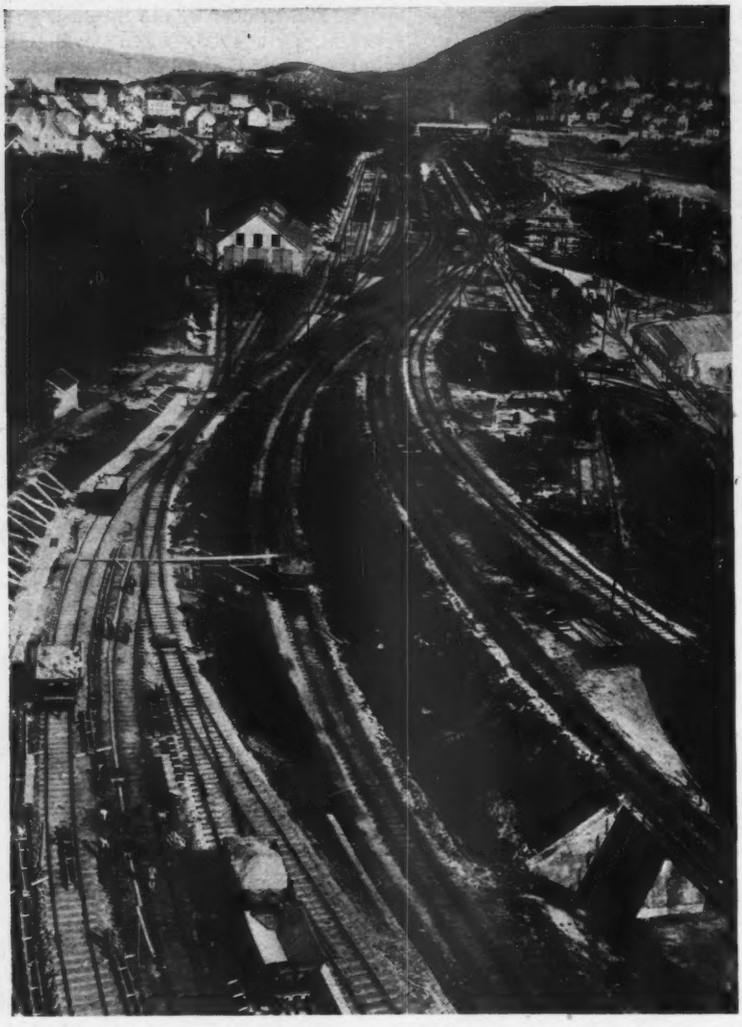
Malmberget (the Iron Mountain), near the town of Gällivare, a group of hills rising about 800 ft. above the surrounding landscape, 60 miles southeast of Kiruna, at 67 deg. latitude, is an older district than Kiruna. Mining here dates back to the middle of the eighteenth century, but large-scale operation was not possible until the railroad to Lulea was completed. This road was built by an English concern, but was later taken over by the Swedish government. In 1903, when Grängesberg-Oxelösund acquired control of L.K.A.B., it also took over Gällivare Malmberg.

The deposits at Malmberget are divided into two groups, Stora Malmen (the big Ore) about four miles long, and Kaptenslagret, only about half a mile long. Both magnetite and specular hematite are found, the latter in the western part of Stora Malmen, where it occurs alone or mixed with magnetite. The ore is found in veins of varying thickness, surrounded by leptite and syenite rock, and often traversed by veins of granite and pegmatite, and has a dip of 30 to 70 deg. to the south and a pitch of 45 deg. to the west. Reserves have been estimated to be 230 million tons, not including Koskullskulle, which is figured as 40 million tons. These estimates may, however, be too low, as the actual depth of the deposits is not definitely known. The deepest workings are below 700 ft., and diamond drillings down to below 1,300 ft. show no decrease in the thickness of the orebody.

Open-pit mining in benches 30 and 60 ft. high was the only method used up to 1899, when underground methods were introduced, and both methods are now in use. High-grade ore is sorted and loaded for shipment, and low-grade ore is transported to the ore-dressing plant. The barren rock is taken to waste dumps or used for underground filling. Some of the mines have individual haulageways; in others the ore is dropped through ore-passes to lower haulage levels serving several stopes and mines. In open-pit work much of the hanging wall must be removed as the depth increases. For this reason this method is gradually being replaced by underground mining. Less than 10 per cent of the ore is now mined in open pits.

On the 656-ft. level tunnels have been driven, serving all the mines in Stora Malmen. Tunnels have also been driven on the other levels, and the different

Train of side-tipping cars dumping ore into bins



About 7 million tons of ore is shipped yearly from the Norwegian port of Narvik, 102 miles from Kiruna

levels are connected with shafts for hoisting men and materials and to the ore passes for conveying the ore to the main level. In Kaptenslagret the drifting system is not employed. Here a shaft called the Central Shaft has been sunk from the surface at the 525-ft. level into the footwall to a depth of 1,280 ft. This shaft serves all stopes at the 909 and 1,050 levels. Formerly underhand and filling methods were used, but these methods have now been replaced by shrinkage stoping, and in some places with the slicing method, as for instance on the 656-ft. level of the Tingvallskulle mine. The stopes are laid out across the ore, or lengthwise with the strike where the deposit is so narrow that it can be mined in one stope. The height of the stopes corresponds to the level interval, which generally is 164 ft.; the width is 26 ft. Five stopes grouped together are separated by 33-ft. pillars, and 6½-ft. pillars are left between the individual stopes. These are caved after the stopes are emptied. The recovery is effected through openings blasted in the rock, which proceed from a crosscut under each stope to the main level.

The ore is hoisted in the Central Shaft with two 5-ton skips, at a speed of 8.2 ft. per second, and hauled on 24-in. tracks in 2½-ton side-tipping Norberg cars, equipped with SKF ball bearings, and drawn by 60-ton Almänna Svenska electric locomotives. A few gasoline engines are also used. The first installation of ball bearings on these cars was made in 1913, and they have performed satisfactorily, not a single failure having been reported. At present over 2,000 cars are equipped with these bearings. Drills and compressors are A.B. Atlas-Diesel and Ingersoll-Rand. Grängesberg dynamite is used for blasting, at a rate of almost one ton a day. All tunnels are illuminated by electricity, but acetylene lamps are used in the working places. Drainage on the main level is done with the aid of trenches, as the flow of water is quite small. At Kaptenslagret two centrifugal pumps have been installed, made by A. B. de Lavals Angturbin, one with a capacity of 4,000 and the other, 2,000 liter per minute. Here the average rate of flow is 1,500 liter per minute, but it may go up to a much higher figure during a thaw.

Only a few stopes contain ore of shipping grade. The major part of the ore is mixed with gangue, occurring as veins and lenses in the deposit, and must be concentrated before shipping. Three ore-dressing plants are in operation, one at Tingvallskulle, another at the Hermelin Mine, and the third at the Central Shaft. The respective plants treat the ore from the 492-ft. level, the 656-ft. level, and Kaptenslagret, respectively. After crushing the ore to minus 8 in. it is passed over a 2-in. grizzly. Undersize from the grizzly goes to vibrating screens and then to magnetic separators; oversize is sent to a belt conveyor, where it is hand picked and divided into three parts, high-grade ore going to bins, waste going to the dump, and middlings being sent to a secondary concentration plant for re-treatment. The magnetic concentrates produced have the following analysis: Tingvallskulle, 61.5 per cent iron and 0.80 per cent phosphorus; Hermelin, 62.5 per cent iron and 0.90 per cent phosphorus; Central Shaft, 65.0 per cent iron and 0.30 per cent phosphorus.

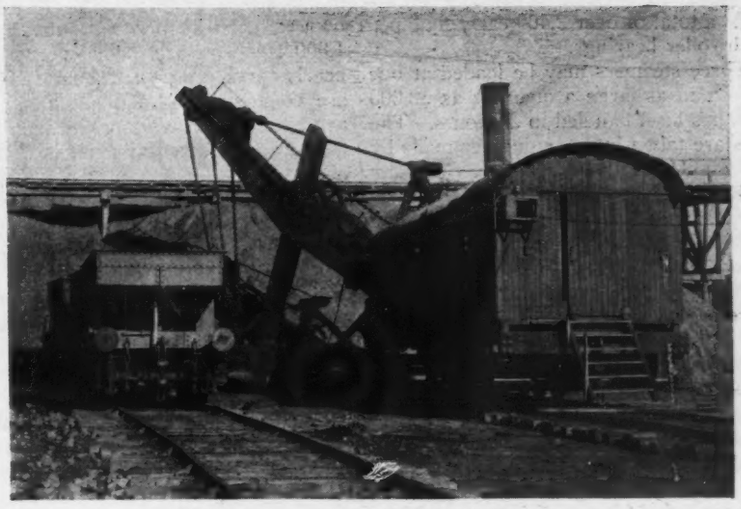
Two plants have been built for the further treatment of the middlings, one in 1913 and the other in 1919. In the older plant, having a yearly capacity of 250,000 tons, the middlings are first crushed to 2 in. and then treated in large-mesh jigs, where 70,000 tons of Grade C concentrate is produced, averaging 65 per cent iron and 0.33 per cent phosphorus. After jigging, the ore is crushed in ball mills to a size of 0.06 in. and treated in magnetic separators, where a concentrate of high phosphorus content is produced. This concentrate is ground in pebble mills to 0.012 in. and re-treated in magnetic separators, producing Grade A concentrate with 70 per cent iron and 0.020-0.025 per cent phosphorus, at a rate of about 40,000 tons per year. The reject from the first magnetic separators is treated in fine-mesh jigs to recover the non-magnetic hematite. About 20,000 tons Grade B concentrate is produced, containing 65 per cent iron and 0.3-0.4 per cent phosphorus.

In the newer plant, which has an annual capacity of 240,000 tons, the method of dressing differs only slightly from that of the older plant. All material is ground below 0.06 in. and concentrated by magnetic separators. The first magnetic concentrate is ground to 0.016 in. and treated in a second set of magnetic separators, where a Grade A concentrate containing 71 per cent iron and 0.02 per cent phosphorus is produced at a rate of 100,000 tons a year. All reject from the first separators is treated in jigs and on tables, producing 60,000 tons of concentrate analyzing 65 per cent iron and 0.3-0.4 per cent phosphorus, classed as Grade B. The ore-dressing plants are built by Morgardshammars Mek. Verkstad, A.B. and A.B. Arboga Mekaniska Verkstad. They are operated on three shifts.

The deposits at Tuollovaara, 2½ miles from Kiruna, discovered in 1892, are estimated at 7 million tons. Underground mining at a depth of 200 ft. is conducted by Tuollovaara Grufaktiebolag, founded in 1900 by nine iron works in Central Sweden, which consume the major part of the output. The ore is transported from the mine to the railroad by a wire-rope tramway built by A.B. Nordströms Linbanor.

About 2,000 men are employed at Kiirunavaara and Luossavaara. To provide attractive living conditions in this inhospitable region presented a great problem, the successful solution of which is a great credit to the founders of the enterprise, especially to the late Dr. Hjalmar Lundbohm. Kiruna, a city of 15,000 inhabitants, does not have the unattractive appearance characteristic of so many mining towns. Great thought has been spent in planning and beautifying the city and to keep it clean and free from smoke. The L.K.A.B. provides houses for the staff and for about half of the workmen, the remainder living in privately owned homes. Excellent public and vocational schools have been provided, as well as theaters and lecture and concert halls. The town is almost completely electrified. Electricity is used in all homes for lighting, heating, and cooking, and the power consumption for this purpose is about 900 kw. distributed among 700 households. Miners receive a pay of 2½ crowns per hour, equivalent to 67c., and mechanics and skilled workmen 3½ to 4 crowns per hour. All of the men are insured against accidents and are given two weeks' vacation after one year's service. A sick-relief fund, to which all men have to contribute, is also in effect. Change houses with shower baths are provided at all plants.

Gällivare, about four miles from Malmberget, has about 7,000 inhabitants. It is older than Kiruna, but the primitive houses originally constructed have given way to attractive homes. Here the company also furnishes the greater part of the houses. It also maintains a sanitarium for tuberculous miners and a summer camp for children of poor health. The average rate of wages is 2 crowns per hour, or approximately 55c.



Loading ore from stockpiles, Lulea

A power plant with a capacity of 100,000 hp. has been built at Porjus, on the Big Lule River, 70 miles from Kiruna. Power is transmitted to Kiruna at a tension of 70,000 volts, 25 cycles, and is stepped down to 2,200 volts. Three rotary converters, with a combined capacity of 2,550 kw., supply direct-current power for the electric locomotives. Two converters, each of 1,500-kw. capacity, change the current to 60 cycles for lighting purposes. The electric equipment is furnished by Siemens-Schuckert, Almänna Svenska, and Luth & Roséns Electriska A.B. A steam plant is used during interruptions in the power from Porjus. Malmberget also receives its power from Porjus, a total of 5,500 hp., and maintains a steam plant of 3,000-hp. capacity.

Most of the ore mined in Lapland is shipped abroad, the Kiruna ore by way of Narvik and the ore from Malmberget through Lulea. Narvik, on the Ofotenfjord, in Norway, situated at 68 deg. latitude, 128 miles north of the Arctic Circle, has a population of about 10,000. Handling of the Swedish ore is practically the only industry. The port is ice-free and differs in that respect from Lulea, on the Gulf of Bothnia, which is closed to navigation for six months of the year, in spite of the fact that it is situated further south, 66 miles south of the Arctic Circle. This difference in climatic conditions is caused by the Gulf Stream, which flows along the western coast of Norway as far as to the Russian border, before it is finally diverted into the Arctic Ocean. The winters in Narvik are therefore not severe, the temperature of the coldest months averaging slightly below 10 deg. F., with sub-zero temperatures only at rare occasions.

Eighteen ore trains a day are usually run from Kiruna to Narvik, at a speed of 30 miles an hour when loaded, making the trip of 102 miles in a little over three hours. The grade is often considerable, and the trains are so heavy that few stops are made. During the winter season the ore generally arrives in frozen condition and the cars must be thawed out before unloading. For this purpose steam pipes, provided with nozzles at regular intervals, have been laid along the track. Experiments have also been made with the use of sea water for thawing the cars.

A large number of the cars are equipped with SKF roller bearings. These bearings were primarily used in order to save maintenance and repair cost, but a material saving in power was also realized, especially in cold weather, when the reduction in friction was found to be as high as 30 per cent. This has made it possible to run longer and heavier trains with the same locomotives. The Royal Swedish Railroad Commission has recently decided to have all remaining cars still using plain bear-

These 35-ton ore cars at Kiirunavaara are equipped with roller bearings

ings, a total of over 2,400 cars, equipped with roller bearings.

Three steamers may be loaded at one time, and as large a quantity as 30,000 tons has been handled in 24 hours. The cars are taken in a car dumper made by Brown Hoisting Machinery Company and emptied into the hold of the steamers through chutes. Average time required for unloading a car is 25 sec. Narvik has a very high tide, 4 to 5 meters (13 to 17 ft.), and the track is therefore placed 22 meters (72 ft.) above low-water mark.

More than half of the ore is crushed before shipping. When it is to be crushed it is transferred from the railroad cars to smaller cars, of about three tons' capacity, and hauled to the crushing plant. Four ore crushers are used, two made by Morgaardshammars Mek. Verkstads A.B. and two by Maschinenbau-Anstalt Humboldt. Here the ore is reduced to about 4 in., loaded into cars of 50 tons' capacity, and transferred to the quay. The ships used for this service range from 3,500 to 12,000 tons' capacity. L.K.A.B. has 25 boats of its own engaged in this transport. Almost 1,000 steamers are loaded per year, or nearly three per day. About 1,100 men are employed at Narvik, where wages average 1.80 crowns, or 48c. per hour.

Lulea, the Swedish port, is a city of about 12,000 inhabitants. The loading quays are in a section of the harbor called Svartön (Black Island), where boats rated up to 10,000 tons can dock. All shipping is discontinued from November to May, when the gulf is frozen. During this season the ore is stockpiled. Most of the ore shipped over Lulea comes from Malmberget and Koskullskulle in trains of 40 to 50 cars, handled by one engineer with an assistant. The trains are switched to the quays on one of three tracks, according to the grade, and unloaded in the same manner as at Narvik. Four steamers may be loaded at the same time. During the shipping season about 400 steamers are loaded, an average of three a day. Most of the ore goes to German blast furnaces and is shipped to the German port of Stettin. Shipments during the year total about 2½ million tons.

During the winter months the ore generally arrives in a frozen condition and must be thawed out before the cars can be dumped. Steam pipes for this purpose are laid along the tracks as at Narvik. Huge stockpiles accumulate during this season.

The entire railroad from Narvik to Lulea, 285 miles, is electrified. Power for this purpose is generated at the Porjus power plant, which also supplies power to the mines. Single-phase current at a tension of 80,000 volts is generated for the railroad.

The Great Lule River, on its way to the Gulf of Bothnia, forms several large water falls, of which only Porjus is developed at present. Many hundred thousand horsepower will be available when these are fully developed. The largest of the falls, Harspranget, has an estimated capacity of 250,000 horsepowers. These falls all belong to the government, and their ultimate development, for which plans have already been made, will greatly enhance the prosperity and industrial importance of Lapland.

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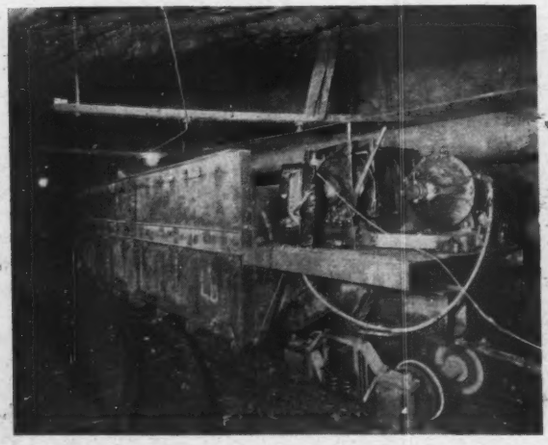
Novel Railway-Type Slusher-Slide Car

EMERSON A. WIGGIN describes the self-propelled slusher-slide car here illustrated, in the July issue of the Sullivan Machinery Company's *Engineering Graphic*. This car was designed by the engineers of the Montreal Mining Company, at Hurley, Wis., for the purpose of mucking a large drift underground. At first, two side-dump muck cars were used, the slide being built on the first car only. A steel plate or bridge connected the two cars and a 15-hp. double-drum hoist was mounted on a platform placed on top of a 6-ton trolley locomotive. The combined capacity of the two cars was 380 cu.ft. The scraper used was a 48-in. hoe type, weighing 800 lb. All of the equipment was moved into the breast, loaded, and brought to the shaft for dumping. Two units of this type were employed in driving the drift, this allowing one to be at the face loading while the other was going to the shaft to dump.

Experience with this equipment demonstrated its practicability. Some delay, however, had been caused in loading because of the use of two cars with a bridge between them. This difficulty led to the design of the car shown on this page, namely a single railway-type mucking car about 22 ft. long and having a capacity of 320 cu.ft., compared with 380 cu.ft. for the two cars previously used. Trucks are provided at each end of the car, which will take a 50-ft. radius curve in a 10-ft. drift. The incline or slide is placed over the forward truck and is built into the car, joining at its top with a grizzly placed at a slight slope over the body of the car. The car itself is of the V-bottom side-dump type. On a platform above the rear truck, as shown in one of the illustrations, a Sullivan 25-hp. double-drum scraper hoist is located. With the new type of car just described some 2,000 ft. of drift has been completed.

Scraper-slide car developed for slushing



Slide end of slushing car

Mine Depletion and the Congressional Hearing

McKinley W. Kriegh

Formerly Tax Counsel,
American Mining Congress

A PERCENTAGE method of computing depletion allowances of mines, similar in principle to the provision of the existing income-tax law in relation to oil and gas wells, and corresponding to the present method used successfully in Canada, has been proposed in a report by the staff of the Congressional joint committee on internal revenue taxation. That committee will hold a hearing on this question at Washington early in December. Mining men throughout the country are affected, because such a change in the income-tax law would be applicable in all cases where new ore-bodies are discovered, or additional ore reserves, not included or contemplated in estimates of March 1, 1913, value, or other basic valuation, are disclosed as the result of exploration and development in existing mines.

Depletion of mines—meaning the reduction in value of ore or mineral in place by extraction and conversion into money by the sale of the product—is and has been for about fifteen years one of the most, if not the most, important feature involved in the audit and adjustment of income-tax assessments of mining taxpayers. In the case of oil and gas wells, it will continue to be an important factor in the determination of income-tax liability throughout the operating life of the properties, without regard to cost, value, date of acquisition, date of discovery, or transfer or change of ownership, excepting only that the annual allowance in any case shall not be less than would be allowable on the basis of cost or March 1, 1913, value. In the case of mines, it will cease to be important when the basic valuations are used up, except in the comparatively few cases where the taxpayers are able to establish discovery value on mineral deposits that are "not merely the uninterrupted extension of a continuing commercial vein or deposit already known to exist, and if the discovered minerals are of sufficient value and quantity that they could be separately mined and marketed at a profit." That is, it will cease to be of any considerable importance to the mining industry, as a whole, unless some plan is adopted that will return to the owner-taxpayer the value in place of his total ore or mineral production as in the case of oil and gas.

Allowances for depletion in considering the case of oil and gas wells continue as long as production continues; in the case of mines they end when the valuation or other basis is exhausted. This is because the 1926 and 1928 revenue acts provide that "in the case of oil and gas wells the allowance for depletion shall be 27½ per cent of the gross income from the property during the taxable year," subject to a limitation of 50 per cent of the net income of the taxpayer from the property. Under this provision, the same right to depletion, and the same allowances, relatively, are granted the large corporate operator and the small individual wildcatter alike, regardless of when or how the property is acquired, or whether by purchase or discovery.

The enactment in 1926 of this percentage depletion method for oil and gas wells followed the 1925 report of Senator James Couzens, of Michigan, for the Senate select committee of which he was the chairman, in which he outlined and proved the existence of unsatisfactory conditions, including gross discrimination between different classes of taxpayers in the oil and gas industry, that existed under the system of determining depletion allowances on the basis of valuations of oil and gas wells under the discovery provision. A similar provision for mines doubtless would have been worked out at the time for the mining industry if the several branches of the metal mining industry had been able to get together and agree upon the principle. The method is satisfactory to the oil and gas industry, and is simple of administration.

In numerous cases, mining companies that will be good dividend payers for many years to come have already exhausted their bases for depletion, although the value in place of ore discovered and developed during recent years, and not included in any valuation for depletion purposes, exceeds that originally determined and allowed as of March 1, 1913, or other basic date. Others have only a nominal allowance, although possessed of valuable and extensive ore or mineral deposits, owing to the fact that impracticable and technical requirements of the income-tax law and regulations prevent relief under the discovery provision. Many others have never had the "reasonable allowance for depletion" provided for by law. Still others are approaching the time when existing bases for depletion will be exhausted. In most of these cases the unfavorable situation is due to under-valuation of the mines, resulting from erroneous estimates of ore or mineral reserves, which, however, may have been the best that could be made at the time. Only in comparatively few cases have such situations been corrected, in varying degrees, through valuation set-ups that by ingenious effort and reasoning have been made to dovetail with the requirements necessary to sustain the application of the discovery provision.

The existing situation in the metal mining industry may be illustrated by the following examples:

The "M" mining company owned and operated a mine at March 1, 1913, that was developed sufficiently to permit a reasonably accurate measurement and estimate of ore reserves. It secured what may be termed a 100 per cent valuation, and has no present depletion problem, for the valuation will cover the life of the mine.

The "N" mining company owned and operated a partly developed mine at the basic date, and it was necessary to examine into the experience of similar mines in the district and other factors in order to determine the probable life of the property and the probable extent and amount of the company's ore reserves. The valuation allowed was, we will say, 60 per cent of that claimed, although operations since then have proved the existence at the basic date of two to three times the value allowed, and considerably more than that claimed by the taxpayer. In this case, there was no interruption in the continuity of the vein or deposit originally valued, and therefore discovery value cannot be allowed under the statute. Neither will the revenue department per-

mit revaluation on account of gross error, although the regulations clearly make provision therefor. This case is typical of many lead-silver and some iron-mining properties. Here was gross error, though not intentional, on the part of both the taxpayer and the government valuation engineers.

The "O" mining company presented a situation similar to that of the "N" company, except that its evidence concerning similar mines in the district and its engineering data were more convincing. It was allowed the full valuation claimed. It since has discovered and developed ore reserves far in excess of the quantity originally claimed. Again, unintentional gross error occurred. Again, there is no relief under the discovery provision of the law or under the regulation providing for revaluation in case of gross error in estimating the most important factor of the original valuation. This, also, is a typical case in the metal-mining industry.

However, "X" company, whose case appeared to be similar to that of the "O" company at the time of the original valuation, exhausted its mine before it had used up the valuation allowed for depletion purposes because of the intervention of a fault. After considerable exploration and development work at various levels in the old mine, it picked up the original vein and found values far in excess of those originally claimed. Because of the fortunate interruption of the fault, the taxpayer was allowed full discovery value on the ore thus discovered, although, except for the fault, the situation of "X" company was no different from the conditions affecting "N" and "O" companies, which were denied discovery value. This is typical of cases where an interruption occurs to break the continuity of vein or deposit originally valued, and there is a rediscovery.

"Y" company purchased a farm that its promoters believed might contain zinc. The property was prospected by the use of core drills, and a large deposit of zinc was found. Later, another was located, and, still later, another was proved. The logs of the core drillers proved that barren ground interrupted these three deposits, so that the taxpayer was allowed discovery value on the first deposit discovered, and additional value for each of the others as of the dates when they were shown to be "of sufficient value and quantity that they could be separately mined and marketed at a profit." Neither the "N" nor the "O" company has any such avenue for protection of its capital values from the application of the income tax.

On the contrary, however, "N" and "O" companies, if they still have four or five years' depletion on the original bases, are confronted with another problem that is even more aggravating than their inability to secure discovery value. Under their original valuations, their rate of depletion per unit of extraction is 30. Call it 30c. or $30, the result is the same for the purpose of this example. Each valuation covered 10 million units. Each mine now discloses 30 million units, which might have been valued. The revenue department may, as it already has done in some instances, apply the revaluation regulation, and add to the original 10 million units valued the 20 million additional units now known to exist, without adding the value of these 20 million to the original value allowed; with the result that the rate per unit of extraction is reduced to 10 or possibly less, depending upon other factors used in the revaluation such as risk rate, grade of ore, life, and cost. And this procedure would be justified as "reasonable according to the peculiar circumstances of each case."

These examples and observations are not new; neither are they exceptional nor local. They are found in every state and district where metal mining is carried on. They have been supported by one authority on the subject after another. It is illuminating to note what officials and former officials of the Treasury Department have had to say about the situation at different times during the last seven or eight years. Words in parenthesis are explanatory:

"This clause (referring to the discovery provision) should be given thorough consideration by the mining industry before it is finally written into the 1924 law, thus further perpetuating gross discrimination."—Albert H. Fay, in *Engineering & Mining Journal-Press*, Feb. 9, 1923.

"If something could be done in the law to do away with the necessity for valuing mineral properties for the purpose of determining depletion, it would be the biggest help of anything that has ever been done to the bureau of internal revenue. . . . It would help the administration of the bureau tremendously and would certainly be more accurate than the present system."—A. W. Gregg, at hearings before the Senate Select Committee on investigation of the Bureau of Internal Revenue, 1925.

"I think that no one thing so conduces to delay and complexities of the tax laws as the necessity for valuation. I think it may be possible and I hope that the department, some representatives of which are present, will bestir themselves to make suggestions to get away from the . . . problems of valuation, the solution of which problems means the exercise of judgment and differences of opinion, mistakes and delay. If there is any human way of getting away from that, the government ought to get away from it."—Dr. T. S. Adams, at hearings before the Senate Select Committee, 1925.

"The taxpayer on the unit basis of depletion does not get a return of his entire capital, because in the years in which he is making no profit, or running at a loss, he writes off depletion which he can never get back as a tax deduction."—John Alden Grimes, in testimony before the Senate Select Committee, 1925.

"If one will take into account the enormous expenses of administration by the method that demands individual valuations, it seems he cannot fail to believe that the government will be far better off in the long run to adopt a simple percentage method."—Dr. L. C. Graton, in a report to Canadian authorities, March 14, 1923.

"The method of determining a reasonable depletion, as provided for in the United States federal income tax laws, has been given considerable study, and I fully concur with Dr. Graton as per copy of his report forwarded to me."—J. C. Dick, in a letter to the Mining Association of British Columbia, 1923.

"From the standpoint of federal taxation for the future there is no valid reason for the continuation of the valuation of the taxpayer's individual developments of new ore reserves in the natural course of his mining operations. It should be of no interest to the government from what hole in the ground the ores are mined as long as it receives the right amount of tax from the taxpayers."—Alexander R. Sheperd, in a report to L. H. Parker, chief of staff of the Congressional Joint Committee on Internal Revenue Taxation, 1928.

"The administrative defects under the present system are (1) lack of uniformity in computing depletion, due to the exercise of individual judgment; (2) lapse of time between the basic date and the examination of the return; (3) inability to secure sufficient evidence to establish a correct valuation; and (4) excessive expense to both government and taxpayer."—L. H. Parker, in his report to the Congressional Joint Committee, 1929.

One might go on indefinitely if complaints from within the industry were to be quoted. The foregoing quotations are from officials and former officials of the government, who cannot defend the system under which such numerous inequalities and discriminations between taxpayers exists, and who, therefore, rest the blame on the law. They say, in effect: "We have done the best we could. We have endeavored scrupulously to administer the law fairly. The mistakes made are not due to inefficiency on our part. But the situation can be corrected if Congress will act." And no one in the mining industry questions their honesty of purpose or the accuracy of their conclusions concerning the difficulties of the depletion problem.

o question should arise in the mind of any mining man concerning the feasibility of a percentage-of-net-income method of computing depletion, such as is proposed by the so-called Parker report under his plan No. 1, which is similar to the method adopted by Canada. The Canadian method allows 33⅓ per cent of the net income from the property, and also allows the stockholders of a mining company 33⅓ per cent of the amount of

dividends from profits on mining operations, as a deduction for depletion. The present percentage provision of the income-tax law applicable to oil and gas wells allows 27½ per cent of gross income from the property as depletion, subject to the limitation that the allowance shall not exceed 50 per cent of the net income from the property, and, further, that it shall in no case be less than it would be if computed on the basis of cost of March 1, 1913, value. The latter clause is not the exact wording, but is the meaning of the Act. Is there any reason to believe that Congress will do less for the mining industry of this country than Canada has done for the mines of the Dominion? Or, will it be the policy of Congress to deal less favorably and justly with the metal-mining industry than with the oil and gas industry?

A few inquiries have been made concerning the effect of a percentage method of depletion determination upon the provisions of the present law relating to net losses, gain, or loss in case of sale, dividends, consolidated returns, and settlements for prior years. They all may be answered with the same observation, that the allowance of discovery value does not interfere with the administration of these provisions. Some changes in the law here and there may be necessary to give full recognition to the depletion principle under the percentage method; but if the percentage basis recommended is adopted, such action, of itself, is a broader recognition of the depletion principle than has heretofore been possible, for it would make depletion dependent upon true capital value, and would continue the allowance throughout the operating life of the property, whereas the present allowance on any basis is of limited duration. Intelligent legislation will therefore include whatever other changes or amendments of the law are necessary to make the principle fully applicable and effective.

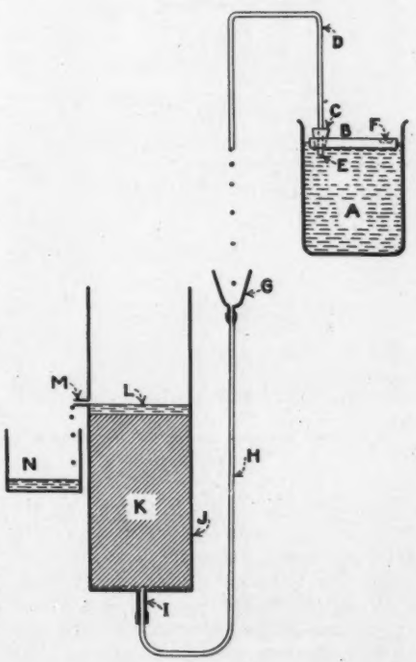
This discussion of the situation is designed primarily to inform busy mining engineers and operators of the present situation respecting the subject matter to be considered by the Congressional joint committee at the hearing in December. A few will not agree with the comments favorable to the percentage method made herein. As to them, the writer has no apologies to make for endorsing the views of such authorities as Dr. L. C. Graton, J. C. Dick, Albert H. Fay, A. R. Shepherd, and Dr. T. S. Adams, wherever such endorsement appears; and the findings of L. H. Parker, chief engineer of the former Senate Select Committee and chief of staff of present joint committee, who has carefully studied this question for six years. The fact is that an opportunity is now afforded the metal-mining industry to present such a strong case to Congress that a constructive effort to perfect the depletion section of the income-tax law, and secure full recognition of the depletion principle, will result. This is the first real opportunity the industry has had since 1918 to present its case to Congress independently of other issues and uncomplicated by the pressure of other considerations.

Apparatus for Circulating Liquids

John D. Sullivan
Associate Metallurgical Chemist
U. S. Bureau of Mines, Tucson, Ariz.

DURING leaching experiments performed at the Southwest Experiment Station of the U. S. Bureau of Mines, in co-operation with the department of mining and metallurgy, University of Arizona, a means of circulating leaching solution through the ore by upward percolation became necessary. A constant rate of supply of leaching solution was also required. As solution was circulated at the rate of only one or two liters per hour, a centrifugal pump sufficiently small could not be secured, and, as the solutions contained bivalent salts of iron which should not be oxidized, an air lift could not be used. The simple apparatus shown in the accompanying illustration was developed and met the requirements. Part of the apparatus may also be used for measuring small quantities of any liquid, such as a flotation reagent. Use was made of the device for maintaining a constant rate of flow of liquid[1].

In the sketch of the apparatus, *A* is a crock or other cylindrical containing vessel; *B* is a piece of wood cut in a circular form of diameter slightly less than that of the container *A*; *C* is a cork that fits into a hole bored in the float *B*; *D*, which is a piece of glass tubing bent to act as a siphon, passes through cork *C* and down into the solution in *A*. When a small container is used and the weight of *D* is so great that *B* is tilted from the horizontal, lead or other heavy material may be placed in hole *F*, which is bored part way through the float on the side opposite the cork. Solution may be siphoned from *A* drop by drop or in a continuous stream. The siphon can be raised or lowered by moving tubing *D* to give any desired solution head. Solution drops or flows into funnel *G*, whence it passes through rubber tube *H* and inlet tube *I* into leaching vat *J*. It then passes upward through the ore, *K*, and overflows through pipe *M* into container *N*, whence it may be returned to *A*. The ore, *K*, can be flooded to any desired depth, *L*, depending on the elevation of the overflow pipe.



Sketch showing method of maintaining a constant rate of flow

Once the desired rate of flow or drop is obtained by choosing tube *D* of the proper bore and manipulating it to secure the required hydrostatic head, this rate can be maintained indefinitely. As the solution level drops, the float drops the same distance, and the same hydrostatic head prevails; likewise, the same hydrostatic head is maintained when solution is transferred from *N* to *A*. If a very slow drip is desired, the end of tube *E* may be constricted. The constriction is better placed at the end that is in the solution rather than at the outside end, because crystallization of salts may seal off the latter end. Evaporation of solution while in the form of droplets in the air can be avoided by surrounding the drops with a glass tube. Solution may be circulated as slowly as one liter per day.

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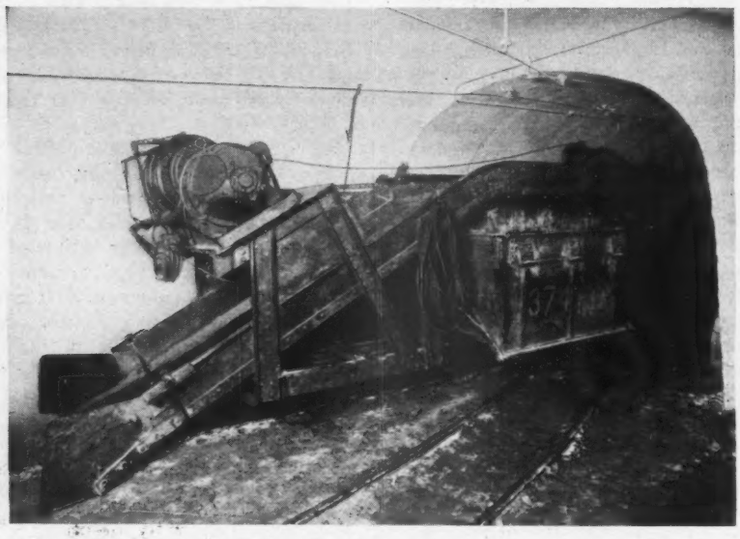
[1]Sullivan, John D.: "Device for Maintaining a Constant Rate of Flow of Liquids." *Jour. Ind. and Eng. Chem.*, Analytical Ed., Vol. 1, 1929, p. 233.

Underground Scraping Practice



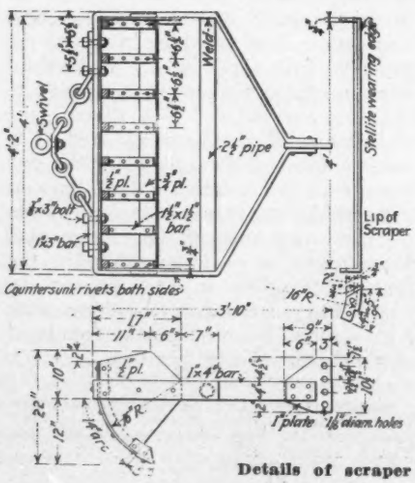
Scraper slide on the 1,000 level of the Miami Copper Company's mine at Miami, Ariz.

A. J. McDermid

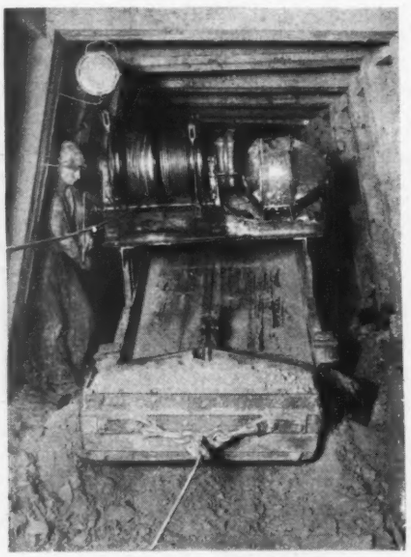
Mining Engineer, Miami Copper Company, Miami, Ariz.

RECENT innovations underground at Miami Copper are a scraper and slide for mucking out haulage drifts. Both were built at the company's shops to meet conditions at Miami, following an investigation of scraper equipment in use at other mines in the region.

The scraper is pulled by a Sullivan HDE-25 5,000-lb.-capacity hoist geared to a Westinghouse, Type SK, 25-hp., d.-c., motor. Motor and hoist are mounted on the slide. Three-quarter inch wire ropes are used on both drums of the hoist. The load rope, 100 ft. long, passes from the hoist through a No. 10 Sullivan roller-bearing sheave that turns on a swivel at the rear end of the slide. From the sheave the rope passes to the front of the scraper, to which it is fastened by Crosby clips.



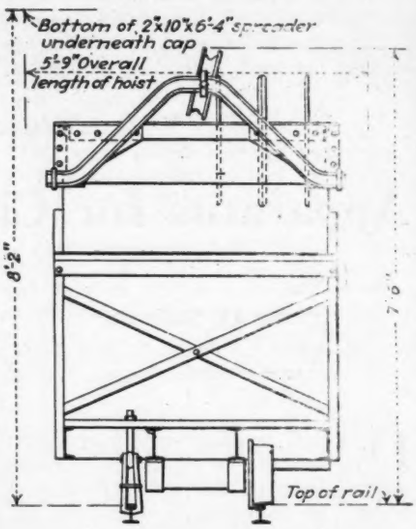
Details of scraper



A loaded scraper about to be hoisted up the slide

The 125-ft. tail rope, fastened to the back of the scraper, passes from the hoist through a similar sheave hooked to an eye-bolt in the face of the drift.

When the equipment was first placed in operation, the scraper did not bite sufficiently into the muck pile to pick up a full load. This difficulty was remedied by bolting a piece of iron on the rear end to increase the weight on the lip. When the end of the track is close to the face, the slide can be set up at the edge of the muck pile. It is held in place by clamps that fit over the track rails. Inasmuch as the rails are 30 ft. long, the maximum distance from the end of the track to the face, and therefore from the slide to the face, is about 35 ft. During a part of the scraper's trip, the load rope drags on the curved part of the slide where the incline joins the horizontal section. This curved piece is given a torch treatment of stellite that prevents grooving of the plate and reduces wear on the rope. Before the stellite treatment was adopted, an unsuccessful attempt was made to use a roller at the curve.



End elevation of scraper slide

The scraper and slide are used in standard haulage drifts that are timbered with 10x10-in. Oregon pine, previously treated with zinc chloride in the company's treatment plant. The caps are 8 ft. long; the posts on the ditch side, 9 ft. 6 in.; and the other posts, 9 ft. Posts are battered 2 in. per foot of length. Sets are spaced 3 ft. 1½ in. apart, center to center, in the type of ground through which drifting is now being done. The rock is Gila conglomerate, composed mainly of schist boulders in a sandy matrix. It is not difficult to drift through when dry, but must be closely timbered. The back of the drift must be caught up immediately after a blast to prevent sloughing.

Rounds are usually drilled to break enough ground for two sets, or an

average length of 6 ft. 3 in. This amount of muck, which will fill fifteen 75-cu.ft. capacity cars, is mucked out by the scraper in about two hours, including the time for switching the scraper and slide in and out of the drift and for switching the cars when the face of the drift is 500 ft. distant from the switching point. Cars are switched and loaded one at a time.

When mucking conditions are good —that is, when the muck pile is high— four scraper loads will fill a car in three minutes. Switching a car requires about the same amount of time and is

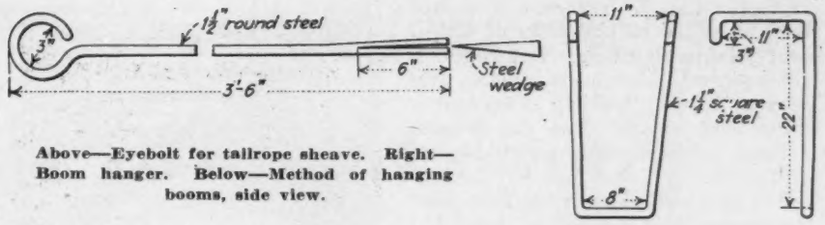
Scraper on muck pile, and booms in place

done at present with Jeffrey storage-battery locomotives. The scraper cleans the face so that no hand mucking into cars has to be done to lay track or put in timber, but the sides of the drift behind the slide have to be cleaned by hand.

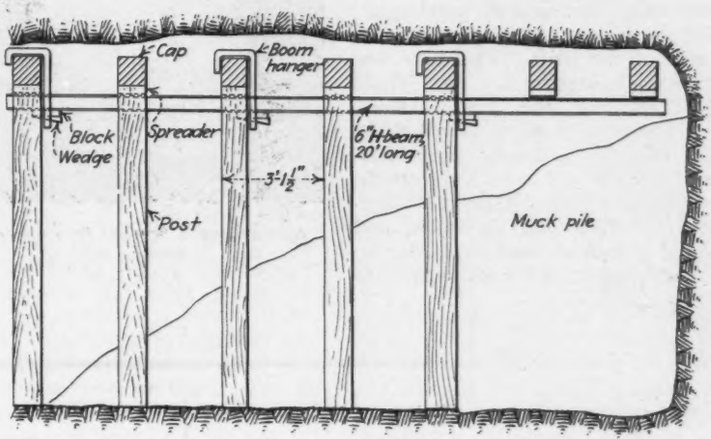
The mucking crew consists of the scraper operator, motor man, and one man to pick down the sides of the muck pile. By hand, three men require eight hours to muck out the round that the scraper cleans up in two hours. The contract rate for the labor of driving the drift with the scraper is at present $8.75 per foot. When the muck was shoveled by hand the rate was $11 per foot. The bonus earned by the men is about the same in each case. A single contract, including driving the drift and laying pipe and track, covers all the haulage drifts on the level.

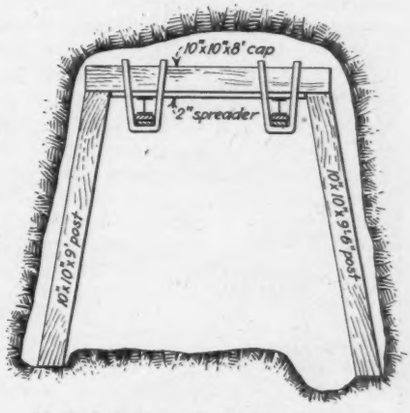
Under good conditions the cycle of operations can be completed in eight hours; that is, a 6-ft. round can be drilled, blasted, mucked out, and timber erected in one shift. The time consumed for each operation is about as follows: Drilling and blasting, 2 hours; placing booms, two caps, and two eyebolts, 1½ hours; mucking, 2 hours; placing four posts, 2½ hours.

Drilling is done with three Ingersoll-Rand, Type N-75 machines. Two of these are mounted on two vertical bars, and, while they are drilling the upper holes, the third machine, unmounted, is drilling the lifters. A round consists

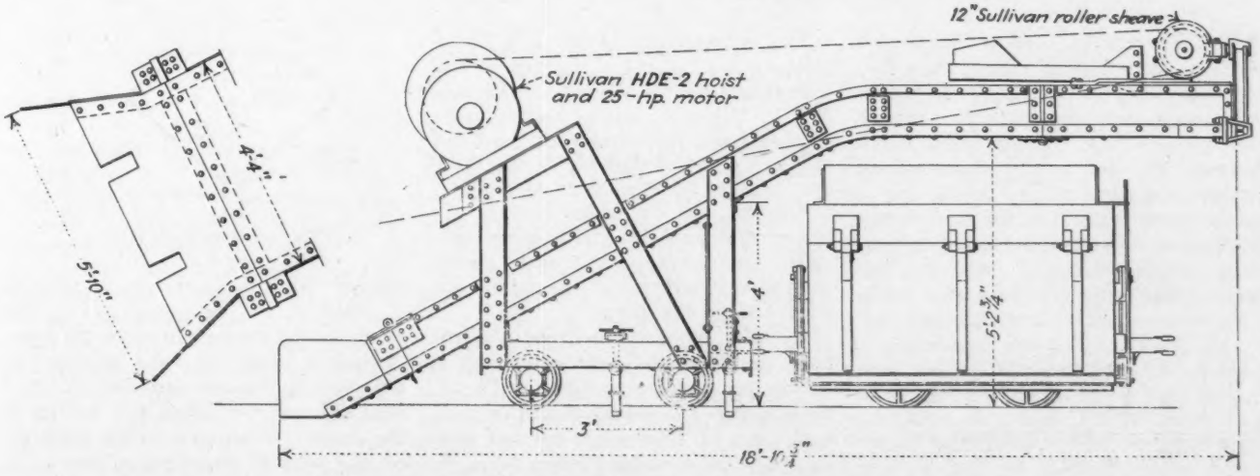


Above—Eyebolt for tailrope sheave. Right—Boom hanger. Below—Method of hanging booms, side view.





Method of hanging booms, end view



Side elevation of 52-in. scraper slide designed by Miami Copper Company

of from 14 to 17 holes and is blasted with from 100 to 120 sticks of 40 per cent gelatine dynamite. Detonation is accomplished electrically, with caps of nine delays. Drilling equipment is transported to and from the face on a truck equipped with racks for the drill steel.

The first work done at the face, after the smoke from blasting a round has cleared away, consists of moving the booms ahead so that their ends reach the face of the drift. Two caps and sufficient back lagging are then placed in position and the caps blocked. Booms are used in all timbered drifts in the mine as a safety precaution. After the back has been thus caught up, two plugger holes are drilled. Eyebolts are wedged into the holes, and the round is then mucked out. Placing four posts under the caps completes the cycle. The crew for each drift comprises five men: a timberman, two machinemen, a scraper operator, and a motorman. Those not engaged at the face clean up the drift back of the slide, place side lagging, lay pipe, unload timber, and bring up supplies to the face.

Discharging a scraper into one of the loading cars

Before building the scraper and slide just described, the company tried out a smaller unit that has a slide 34 in. wide and a scraper 31 in. wide; this unit was made by the El Paso Foundry & Machine Company. The hoist on this slide is a Sullivan 6½-hp. Turbinair, the capacity of which is 2,000 lb. This scraper requires about twice as much time as the big one to muck out a round. It is still in use, and its satisfactory performance was the determining factor in the decision to build the larger unit.

Water Curtain Abates Dust Nuisance

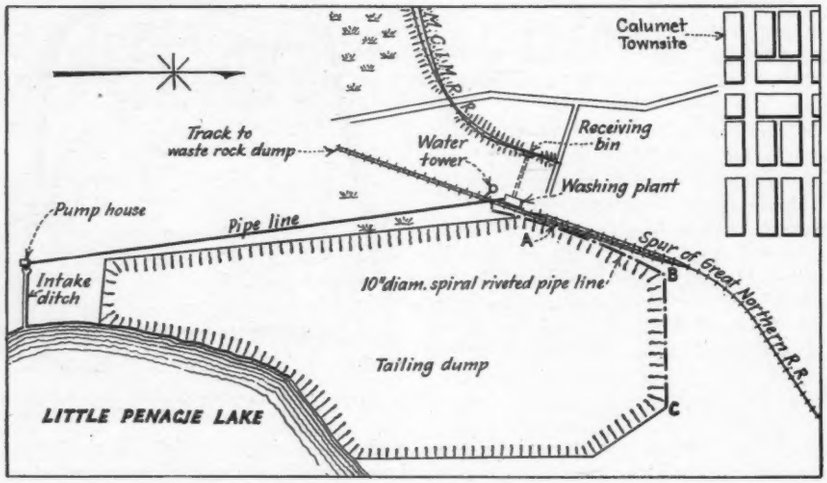


Fig. 1—Sketch map showing pipe line (A B C) for water curtain at the Hill-Trumbull washing plant

IN THE concentration of iron ore on the western Mesabi range, huge tailing dumps are formed that consist of a mixture of sand and 10 to 15 per cent fine iron-ore dust. When a tailing dump becomes dry and a stiff breeze blows across it, a cloud of dust arises that is more objectionable than the sand storms of Kansas, inasmuch as this dust contains fine particles of iron ore that leave a rust stain wherever they settle.

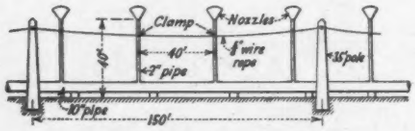


Fig. 2—Arrangement of piping

The tailing dump of the Hill-Trumbull washing plant is situated a half mile from Calumet, Minn., as shown in Fig. 1. When the wind blows from the southeast and the surface of the dump is dry, a cloud of dust blows into Calumet, causing heavy damage to the merchants, as well as in the homes. To remove this nuisance and to avoid lawsuits, a water curtain of unusual design was constructed along the north and west sides of the dump.

A 10-in. spiral riveted pipe was run from the 20-in. diameter mill main, as shown by the broken line in Fig. 1. From point *A* to corner *B* and on to *C*, a distance of 1,800 ft., a vertical piece of 2-in. pipe is welded every 40 ft., as indicated in Fig. 2. On top of each 2-in. pipe is a home-made spray nozzle the details of which are shown in Fig. 3. The vertical pipes are supported by a ⅝-in. cable strung on a pole line 30 ft. high, the poles being set 150-ft. apart. Water requirements are about 1,500 g.p.m., pumped on a 200-ft. head. When the dust cloud strikes the water curtain the dust particles are dampened and fall with the spray.

The water curtain system has been in use about sixty days and is giving satisfaction. It is operated only when the wind is from the southeast, as the dust rising in any other direction causes no damage. Only one improvement in the original design has been necessary; that was to drill additional holes along the narrow sides of the nozzle, in addition to those at the top, to stop any dust from passing through between the pipes. A height of 40 ft. was selected, as observation showed that the cloud of dust did not rise above this height on the dump. When it reached the trees on the edge of the dump, however, it rolled upward a hundred feet or more.

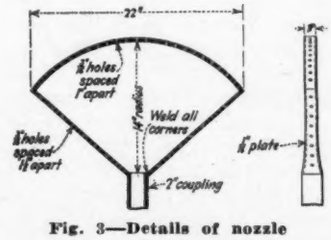


Fig. 3—Details of nozzle

Technical Progress in the Lake Superior Iron Country

A Résumé

BENEFICIATION and electrification being the topics of major interest in the Lake Superior iron region today, it was natural that they should receive considerable attention at the meeting of the Lake Superior Mining Institute on the Mesabi range on Sept. 10 and 11. An account of this meeting appeared in *Engineering and Mining Journal* of Sept. 25, but space limitations forbade more than brief reference to the papers presented. In the following, a brief summary of them will be given.

Four of the papers dealt with aspects of beneficiation. One, by Stanley A. Mahon and T. B. Counselman, discussed developments in washing Mesabi iron ores. The so-called standard Mesabi flow sheet, developed in the Trout Lake concentrator, at Bovey, was used unchanged for fifteen years. During the last six years, however, deviations from this flow sheet have been made, in consequence of the changing nature of the ores and a general trend toward simplification. In general, the increasing amount of silica in the ores has been responsible. An account of iron-ore washing practice on the Mesabi, by the authors, will be given in a forthcoming issue of *Engineering and Mining Journal.*

Of the methods used for improving the grade of Mesabi ores, the Rheolaveur process is newest and perhaps the most interesting on that account at this time. It is being used by Butler Bros. at their three plants at Cooley, Minn., in conjunction with jigging. Descriptive details of one of these installations were given in the account of the Institute meeting in the Sept. 25 issue. The principles involved and the results obtained are set forth in a paper by M. P. Walle. Experimental work at Cooley was begun in 1929. Although, generally, the process is used by combining three types of units—the sealed-discharge unit, the free-discharge unit, and the silt unit—only the free-discharge type is used at Cooley.

In his paper, Mr. Walle describes the sealed type, the simplest of the three. In brief, it consists of a classification launder of definite slope, length, and width, in which is maintained a flow of water under constant head, though susceptible of regulation. Given proper conditions, a true hindered settling condition is brought about, it is claimed, under which a concentration of the mineral is effected. The second essential part of this unit is the operating launder in conjunction with the patented Rheo boxes. Through these boxes a concentrate may be drawn with minimum disturbance to the stratification, or, by breaking across the bed of concentrate by means of a rising current of water, an intermediate product may be drawn off through the spigots. The third essential part of the unit is the tailing chute, which is fitted with a dewatering and screening device, permitting discharge of a finished tailing. By placing five of these units, or launders, one above the other in each of the installations at Cooley, a flexible arrangement is obtained, whereby the original feed may be split into concentrate, recirculation material, and tailing, as desired, adjustments to meet changes in feed being readily accomplished.

Mr. Walle then endeavors to explain the principles on which these boxes operate, and to show graphically how the recirculating material is obtained and maintained, and how it creates "the crowded mass shown by Henry as necessary and sufficient to create the bed with a definite angle depending on specific gravity only." The fundamental principles are the same for each of the three types of units, he says.

A. T. Sweet, professor of metallurgy at the Michigan College of Mines and Technology, summarized in a brief paper the results of the year's research on iron-ore beneficiation at the college. Fundamental metallurgical experiments conducted during the preceding year had brought out the need for a complete field survey, which had been duly undertaken. The purpose of this survey is to classify all the iron formations metallurgically as well as geologically, and to estimate tonnages of available formations having economic possibilities.

Geologically, the classification made is: Ferruginous cherts, or soft ore jasper; jaspilite, or hard ore jasper; and magnetite-grunerite formation.

Classification metallurgically places the individual formation into one of three classes whose confines are limited by the present status of our knowledge of the art. The first class includes the formation which, due to its physical and chemical nature, shows indications of amenability to concentration by known methods. The second includes the finely disseminated materials in which the iron cannot be liberated by crushing, however fine, because of chemical combination as silicates, or because the crushing required would be excessively costly by present known methods. In the third class would be included ore which has a satisfactory iron content but which contains some deleterious impurity, as sulphur or phosphorus, the removal of which would make a marketable grade.

In general, the processes of beneficiation are confined to four classes: Washing, reduction, gravity concentration, and leaching. Of these, leaching has been but lightly considered and must be further investigated. Although the four methods are of a type which, if successful, will produce a product that will not disturb present furnace practice, other processes may be discovered which may alter or modify the present procedures considerably. Every method which holds any promise is given consideration.

P. G. Harrison, superintendent of the Evergreen Mining Company, at Corsby, Minn., discussed the experience of his company in adapting the sintering process to soft iron ores. The first plant in the iron country to handle such ores was built at Crosby in 1924. It was designed to beneficiate high-moisture, low-silica, iron and manganiferous ores having a poor physical structure. It proved too small to be commercially successful at the then prevailing iron ore prices. Since 1928, its history has been one of constant rebuilding and enlargement, with gratifying results. Data illustrating this development were given by Mr. Harrison. Tonnage handled has grown from 15,784 in 1926 to 213,022 in 1929. Tons per hour grew from 17.1 in 1926 to 63.8 in May, 1930. The size of the present sintering machine (Dwight-Lloyd) is 18x72x127 in., as compared with 8x42x64 in. in 1926. In May, power consumed (sintering only) per ton was 8.4 kw.-hr.; tons per man-shift, 51.5; coke per ton, 11.1 per cent, or 8.9 per cent carbon; and ignition oil, 0.680 gal. per ton. The following cost figures were given: investment, $1.10;

interest and depreciation, $0.14; repair cost, $0.102; administration and overhead, $0.07.

Details of the flow sheet were given. From the cars the ore passes over a chain grizzly, the minus-2½-in. material going to bins and oversize to a crusher that breaks it to 4 in. Thence over a weighing device to vibrating screens, the minus-½-in. material going to bins for sintering. Screen oversize can be sent directly to shipment or to a hammer mill and crushed to ⅜ in. The crusher discharge is rescreened. Capacity for storing 350 tons of fine material is provided. Fuel is ground in a rod mill to minus-15 mesh, thence going to storage. Ore, fuel, and fine sinter (screened from shipped product) are mixed in a drum-type pug mill, from which the mixture is fed to the head of a sintering machine, equipped with an ignition furnace of the reverberatory type, specially designed for this installation. This burns gas obtained by circulating air and 32-deg. gravity oil. Air is drawn downward through the bed by two fans which furnish 110,000 cu.ft. per minute at 15 to 18 in. of water vacuum. The finished sinter discharges onto a grizzly having 1¼-in. openings.

The flow sheet is flexible. Ore in process of treatment can be simply crushed and shipped; or it can be crushed and screened, the oversize shipped, and the fines sintered; or the entire ore can be crushed and washed; or it can be crushed to minus ½ in. and sintered.

F. E. Boyd gave a brief description of the crushing plants of the Oliver Iron Mining Company. These he divided into two classes: those in which reduction in size is the sole objective; and those in which reduction in size is made to facilitate further treatment. Under the first class are the plants at the Soudan mine, Tower, Minn.; No. 2 Hard Ore mine, Ishpeming, Mich.; Morris mine, Hibbing, Minn.; Riverton mine, Stambaugh, Mich.; at Hibbing, Minn.; at Virginia, Minn.; and at Escanaba, Mich. The last is no longer in operation.

Under the second class is the Trout Lake concentrator, at Coleraine, Minn. The Leonidas plant at Eveleth, Minn., is a combination of both types. In each case, Mr. Boyd outlined briefly the general arrangement of the plant and the tonnage it has handled.

Electrification is a live topic today in the Lake Superior country. F. S. Rice described the electric power system supplying the Minnesota iron mines. Electricity was first applied to iron mining about twenty years ago, and the use of electricity from central stations to iron mining about seventeen years ago. By the end of 1924, all of the central stations were interconnected by high-tension power lines, resulting in a completely unified system, able to deliver power with a high degree of reliability.

To obtain maximum benefit from interconnection the interconnecting lines must be able to handle an appreciable portion of the system load. Benefits thus to be obtained are: protection of consumer's service because of ability to obtain power from more than one source; ability to maintain lines and stations with minimum, or entire absence of, inconvenience to the customer; improvement in frequency regulation, the variation caused by large fluctuating loads being much less noticeable than in the case of a small isolated system; and more uniform voltage delivered to the customer. It is this type of interconnection which is embodied in the Minnesota Power & Light Company's system.

"With respect to the mines, the system is divided into three areas containing the Cuyuna, Mesabi, and Vermilion ranges, each of which is supplied by a system of high-voltage distribution lines, the Cuyuna at 33,000 volts, the Mesabi at 22,000, and the Vermilion at 44,000. Connecting these areas are 110,000-volt transmission lines of high capacity, which extend to the generating plants in and near Duluth. Additional lines of similar capacity are planned. To supply power to the mining areas from the transmission system, substations are installed which transform the 110,000 volts to the particular distribution voltage used in that area. From each substation, which may have a capacity of 10,000 kw. or more, two to six feeders radiate to serve the mines or other load located in the vicinity, each of which feeders is controlled at the station by an automatic oil-circuit breaker, which opens if trouble occurs. The setting of the relays which guide the operation of these breakers is determined after making a short-circuit study of the system, which involves eleven hydro plants, four steam plants, seven high-tension substations, and over 1,000 miles of transmission line. An operating efficiency of over 90 per cent perfect for all outages has been obtained for the system protective equipment. About half of all interruptions can be traced directly to flashovers caused by lightning.

The method of switching employed permits feeding practically every mine from two directions, and results in great improvement to service, as compared to the former method of serving from one line without any possibility of service from more than one direction.

Power furnished to the system includes that from eleven hydro plants, comprising 31 units and totaling 94,911 kw.; also that from five steam-power plants comprising eight units and totaling 31,300 kw., the grand total being 126,211 kw. These plants being widely distributed throughout the system, and being composed of a large number of relatively small units, a high degree of reliability of generation results. An effort is made to keep the system frequency as close as possible to 60 cycles at all times.

That the use of electricity has experienced a remarkably rapid growth in Minnesota iron mines is shown in graphs by Mr. Rice. Use of electricity per ton of ore shipped has also increased. That consumed on the Mesabi and Vermilion ranges combined has increased from approximately 0.35 kw.-hr. per ton shipped in 1918 to 1.8 in 1928.

In discussing the development of mechanical shovels for the Lake Superior iron-mining industry, W. F. Schwedes, of Duluth, said that it might be divided into four principal periods, each marked by major changes in design which in turn had materially affected operating methods. The year 1915, ending the first period, which had started in 1837, marked the heyday of the 4-yd. short-range, swing-circle, railway-type, truck-mounted, steam-engine-driven shovel. About the beginning of the period 1915-20, the study of open-pit mining centered on the cost of removing the overburden, and, as an answer to this problem, the first full-revolving, long-range, steam-engine-driven, truck-mounted shovel was introduced in this district. These machines were mostly of 8-yd. capacity, and incorporated coal crushers, stokers, superheaters, and floodlighting. They loaded stripping, and, in some cases, iron ore at a lower cost than before attained. Their application, however, was limited, owing to the relatively few open-pit properties that combined large winter stripping jobs with summer work, in iron-ore cuts of unmixed grades, large enough to justify their installation.

The next five-year period was marked by the introduction in this district of the first electric power-driven machines. These were similar to the steam-driven 8- and 10-yd. long-range machines mentioned in the foregoing, save that electric power equipment was substituted for the steam equipment, thus eliminating coaling and watering, banking fires, and boiler cleaning. Also, they required smaller crews and in general reduced repair and operating cost.

In the fourth period, 1925-1930, shovel manufacturers, in order to co-ordinate mechanical and electrical parts properly, for the first time set about studying correct values for bail pull, swinging torque, crowding effort, and time cycles; these values in turn were reduced to electrical characteristics of motors and generators, which characteristics the electrical manufacturer accurately designed

and built into his new machines. During this period a large number of full-revolving, 3-, 4-, and 5-yd. machines were placed in service in the district, including several 5-yd. swing-circle machines. The major event of this period, however, is that in it shovel building became a fine art.

M. Schwedes forecasts the future to the extent of saying that in selecting his shovel the future mining man will demand, as desirable shovel characteristics, digging capacity, mobility, low initial cost, low operating cost, and low repair cost. He elaborates this to show in what way improvement may be made to this end.

Repair shop practice at Minnesota iron mines was discussed by Anton Tancig, of Chisholm, Minn. Not only is a better class of skilled men to be had today, but advance has been made in every phase and condition affecting modern repair-shop practice. Better materials and tools are now vailable.

In conclusion, the author stated that the amount of repair work to be done can sometimes be considerably lessened if the equipment is carefully watched and given complete periodic inspections to disclose improper lubrication, wasteful practices, and excessive wear or defects that may cause a shutdown. Everything connected with the shop should be of the latest design and of the best quality in keeping with duty required.

Cuyuna geology came in for its share of consideration in a paper by Carl Zapffe, of Brainerd, Minn., wherein the stratigraphy of the range was discussed. The author presented the following column:

Post-Keweenawan	Shaly sediments and extrusives Acid intrusives
Keweenawan	Basic intrusives and extrusives Acid intrusives
Upper Huronian (Cuyuna Series)	Crow Wing formation I. Cuyuna Member. Consisting mainly of green slaty and schistose rocks (partly volcanic), inclosing the Deerwood iron-bearing member. Strongly magnetic. II. Emily Member. Consisting of some green but largely dark-colored slaty rocks, probably few, if any, volcanics, and many scattered lenses of iron-bearing rocks, which are only slightly magnetic or non-magnetic. Aitkin Formation Gray slates and phyllites. Volcanics absent. Contains some iron carbonate, but extensive iron-bearing lenses virtually lacking. Non-magnetic. Basal Conglomerate
Middle Huronian	Mesabi Group

Chances for finding suitable iron-bearing formation in the area occupied by the Aitkin or Basal formation appear to be exceedingly poor, says Mr. Zapffe. In the Emily member one may always experience much that is tempting by way of ore formation. Much ground remains to be explored. The situation is probably very complex. The uppermost or Cuyuna member, with its clear-cut magnetic belts of long extent, is probably the best one to seek. Good orebodies have been found which are not closely confined to magnetic lines, and some are associated with very weak lines. More deposits should be found therefore when more drilling is done in such places.

R. N. Adams, a fellowship student at the Michigan College of Mining and Technology, presented a paper entitled "Amygdaloid Tailings," the only one printed which dealt directly with copper-country practice. It described experimentation on the re-treatment of amygdaloid sands, satisfactory methods of treating the conglomerates having already been perfected. Tabular data showing results obtained were given.

Pantograph Overcomes Trolley-Wire Difficulties

AN INNOVATION at the United Verde Extension's mine at Jerome, Ariz., is the use of small pantographs instead of standard trolley poles on the electric locomotives employed below the 1,300 level, as an additional measure to overcome trolley-wire difficulties caused by soft and sloughing ground in this particular section of the mine. The pantograph, designed by W. D. Deacon, chief electrician, is made at the local shop. As may be seen in the accompanying sketch, its construction presents several important features, the most interesting of which are an adjustable counterweight instead of springs for tightening the pantograph, and a flexible base, equipped with two toggle-type bearings. The toggles permit a deviation of 6 in. to either side of the center line, thus insuring smooth operation. Figs. 2 and 3 show the design of the toggle bearing and of levers *X*. The counterweight, suspended from a steel cable attached to the levers *X*, is guided by two small pulleys bolted to the upper deck of the base. Levers *X*, with the attached pantograph arms, counterweight, and two connecting levers, rest in four bearings, as shown in Fig. 1. The trolley wheel is insulated by wooden sections inserted between the two upper arms. In addition to the described arrangement, all locomotives operating in places where bad ground conditions prevail have been changed to switch-controlled trolley and storage-battery units, to permit their use in drifts or tunnels where the installation of trolley wire is impossible or too costly.

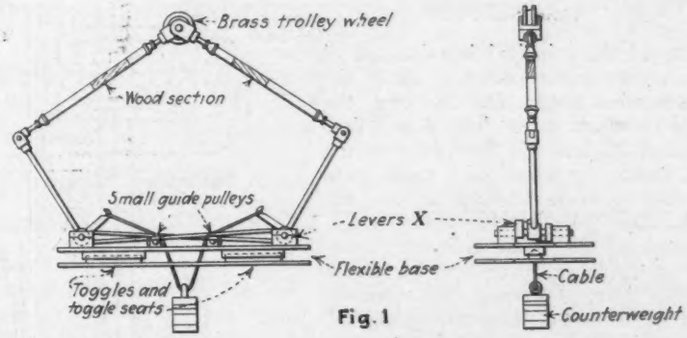
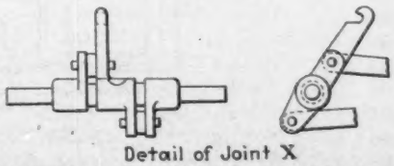


Fig. 1



Detail of Joint X

Fig. 3

Detail of Toggle and Toggle Seat

Fig. 2

Automatic Derailing Switch for Rope Haulage Systems

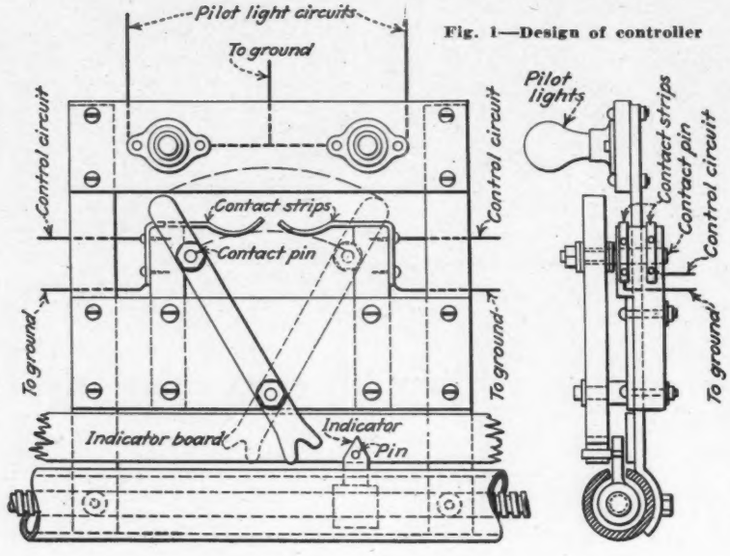


Fig. 1—Design of controller

WHEREVER rope haulage is applied to transport over grades, installation of a reliable automatic derailing device is advisable, because such a device not only insures the safety of workmen but also increases the economic operation of the haulage system by reducing property damage. Many derailing devices have been developed, but most of them are operated manually and are not positive.

An automatic electrically operated derailing switch, developed by the Northwestern Improvement Company, Roslyn, Wash., has proved to be so successful that it has been adopted as standard equipment at all of the company's mines. The following description of the device is taken from U. S. Bureau of Mines Information Circular No. 6226.

One of the principal installations of the Northwestern company is at the bottom of a slope 3,000 ft. long, the grade of which varies from 4 to 8 deg. Trips of 30 cars are lowered over the slope tracks by means of a cable from an electric hoist situated at the top of the slope. A controller (see Fig. 1), actuated by the hoist indicator, operates an electro-hydraulic device at the switch, thus governing the derailer. Pilot lights at the hoist and along the slope indicate the position of the switch at all times. These lights are controlled by a switch linked to the track-switch bridle. They show red when the track switch is set for the derail; otherwise they show green. The general layout is presented in Fig. 2. When a trip reaches a point 300 ft. above the bottom of the slope, the switch is opened or closed by the functioning of the control system.

The controller consists of a double-throw switch actuated through a pin-and-jaw device by the hoist indicator pointer, which makes or breaks the control circuit. A pin on the hoist indicator pointer engages the forked end of the contactor arm and causes the upper end of the arm to move to the right or to the left, depending on whether the trip is approaching or leaving the bottom of the slope. One or the other of the two control circuits is completed by the bridging of contact strips. The bridging is performed by a contact pin mounted on, but insulated from, the upper end of the arm. These two circuits operate the reversing switch.

Near the track switch is installed the reversing switch, a three-pole double-throw type (with a no-voltage release) operated by solenoids, which governs the direction of rotation of a pump motor in the track-switch mechanism. The pump controls the direction of movement of a hydraulic cylinder pis-

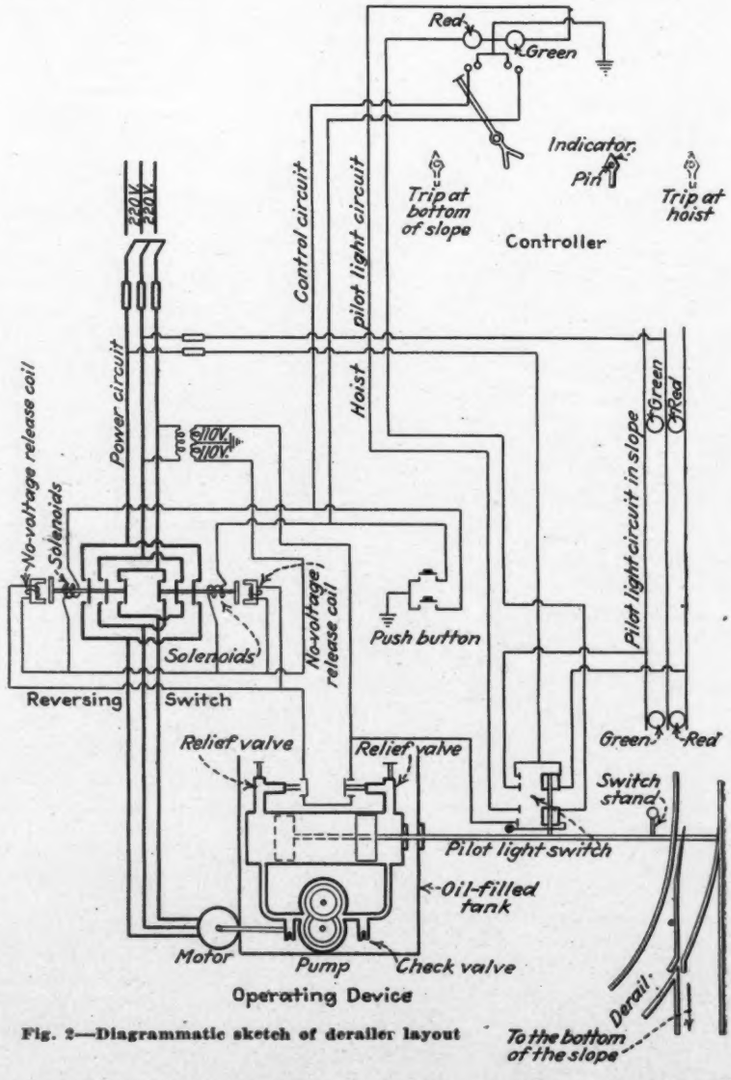


Fig. 2—Diagrammatic sketch of derailer layout

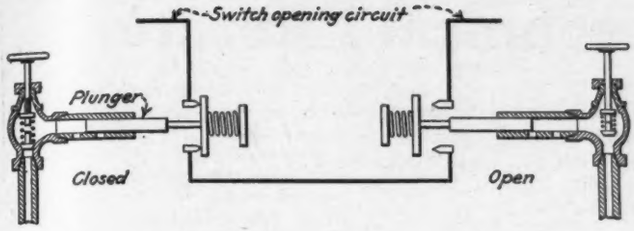


Fig. 3—Details of relief valves

ton and, in turn, the movement of the track switch. Oil is the hydraulic medium. The pump, cylinder, and piping are immersed in a tank of oil.

By being connected through relief valves (see Fig. 3) on the operating mechanism, the no-voltage release coils function in the manner of limit switches. These relief valves are spring-loaded to a pressure sufficient to break the points of the track switch loose, after standing overnight, without overtaxing the pump motor or the mechanism. This pressure limit was determined by a thrust of 300 lb. at the switch points. When the switch points reach their limit of travel, pressure in the working end of the cylinder increases, the relief valve at that end opens, and the escaping oil forces out a plunger in the discharge pipe. The plunger is held in its normal position by a high spring that exerts just enough pressure to make good contact between an insulated bridge, which is mounted on the projecting end of the plunger, and terminal points in the no-voltage release circuit.

Any leakage of oil past the relief valve is allowed to escape, without pushing out the plunger, through a $\frac{1}{16}$-in. hole in the wall of the discharge pipe. This hole is exposed when the plunger is in the normal position. In case the pump has not stopped running after the plunger has been fully extended, the full discharge of the pump is allowed to escape through a second and larger hole, which is exposed only when the plunger is extended.

A push-button control, installed at the switch, permits electrical operation of the switch regardless of the automatic control. The closing of the push-button circuit renders the automatic control inoperative. The switch also may be thrown by hand (a switch stand being provided for the purpose) by disconnecting the piston rod from the switch bridle.

Current is taken directly from the 220-volt circuit for the track-switch operating device and for the pilot lights along the slope. For the control circuits and the pilot light at the hoist, the current is stepped down through a 200-watt insulating transformer to 100 to 220 volts, with the middle point grounded.

Reversing is accomplished by a standard magnetic three-phase switch, with its no-voltage release coils connected in a separate circuit. The pump is an oil-circulating pump from a Chevrolet automobile, direct-connected to a G.E., Type R.K.T., $\frac{1}{4}$-hp., 1,725 r.p.m., 220-volt, three-phase motor. The operating cylinder was made from a sleeve bearing casting and is $2\frac{1}{2}$x$4\frac{1}{2}$ in. Relief valves were made from $\frac{1}{4}$-in. angle globe valves.

As the derailer is controlled by the hoist, it cannot be thrown for the bottom of the slope until the rope is paid out to the point indicating safe arrival of the entire trip at the operative position, 300 ft. above the bottom. Should any cars break away from the trip, or all cars leave the rope, they will be derailed.

Novel Fan Installation

TO GUARD AGAINST a long interruption in ventilation, in case of motor failure, and to provide means of increasing the fan speed when a greater capacity is desired, every fan drive should have multiple driving units of different speeds.

A satisfactory and flexible fan drive has recently been developed at the United Verde mine, Jerome, Ariz., the general arrangement of which is illustrated in Fig. 1. The complete installation consists of a 250,000-cu.ft. fan and a fan drive, comprising a slow-speed motor equipped with a belt drive and a high-speed motor directly connected to the drive shaft by a movable jaw clutch. Several unique features are included in the design of drive shaft. Fig. 2 shows: (1) complete details of the drive shaft proper, which is made of a short length of solid shafting fitted with a coupling halve and a jaw clutch, and (2) the quill shaft or idler, when not connected, with its individual bearings, movable jaw clutch, and drive pulley. The entire unit, mounted on two sturdy cast-iron pedestals, rests in two extra-large bearings. To couple or disengage either driving unit, each clutch is connected to a manually operated rack-and-pinion mechanism, which permits proper adjustment of the clutch when the fan is not in operation.

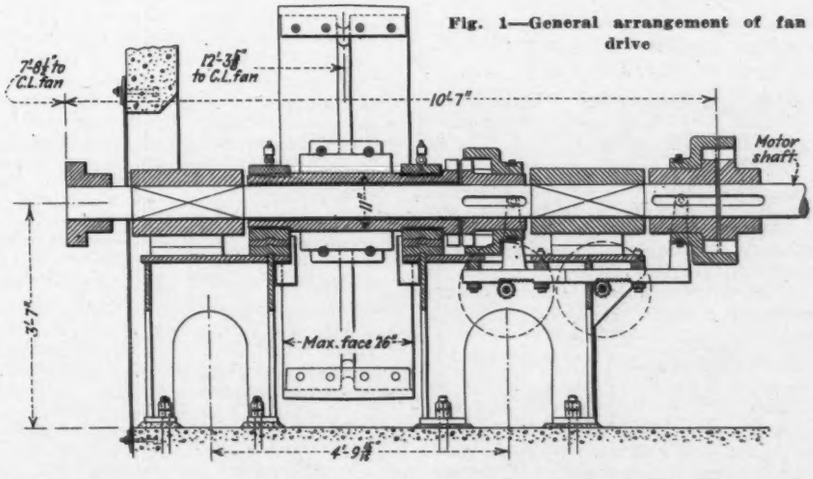


Fig. 1—General arrangement of fan drive

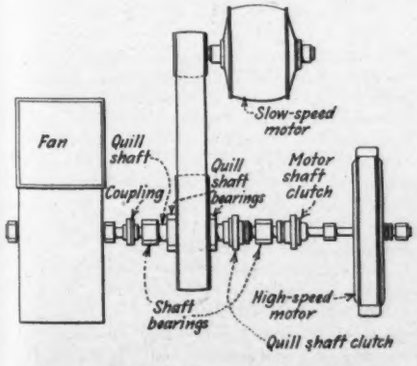


Fig. 2—Details of special drive shaft

Digest of Current Technical Literature

Selected from abstracts of articles in the leading technical periodicals, prepared by Engineering Index Service, American Society of Mechanical Engineers, 29 West 39th St., New York, N. Y.

Lead-Zinc Ore: Flotation — Flotation Plant of the Oued Oudina company. Faerber. *Metallboerse,* Vol. 20, No. 50, June 21, 1930.

DETAILS of lead-zinc flotation plant in *Algeria.*—E.I.S., New York.

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Feldspar Mines and Mining — Black Hills Feldspar Industry Has Interesting History. F. C. Lincoln. *Pit and Quarry,* Vol. 20, No. 12, Sept. 10, 1930.

OPERATIONS of Consolidated Feldspar Corporation, on Hugo feldspar mine, in Black Hills, S. D.—E.I.S., New York.

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Graphite Mines and Mining: Austria—Graphite Mine Feistritz-Heiligenblut, at Poeggstall, Northern Austria. K. Barth. *Montanistische Rundschau,* Vol. 22, No. 17, Sept. 1, 1930.

BRIEF note on deposits, mining and treatment methods, and profitability.—E.I.S., New York.

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Tungsten: China — Chinese Tungsten. *Chem. Eng. and Min. Rev.,* Vol. 22, No. 262, July, 1930.

BRIEF notes on occurrences of tungsten ore, mining methods, ore trading companies, and marketing conditions; tabular export data; molybdenum ores often occur as by-product with tungsten ore.—E.I.S., New York.

•

Gold Ore Treatment — Getting Gold With Grease. *Oil-Power,* Vol. 5, No. 8, September, 1930.

GREASE concentration, used for years to separate diamonds from earthy material in South Africa, is now successfully adapted to recover gold and other metals from low-grade ore dumps.—E.I.S., New York.

•

Zinc-Ore Treatment, Electrolytic: France — A New Electrolytic Zinc Plant in France. *Min. Jl.,* Vol. 170, No. 4958, Aug. 30, 1930.

BRIEF news item of Compagnie Française d'Electrolyse project for 10,000-hp. power plant and electrolytic zinc plant at St. Martin sur la Chambre, in Savoy; estimated total cost is 13,500,000 fr.; raw material to be treated is said to be chiefly residues, and not ore.—E.I.S., New York.

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Copper Smelting—Blast Utilization in Converters in the Blowing of Copper Matte. O. Barth. *Metall und Erz,* Vol. 27, No. 16, August, 1930.

DEFINITION of terms blast utilization, excess air, blast consumption and requirement; review of literature; blast supply of Mansfeld converter in 1928 and 1929; normal air utilization.—E.I.S., New York.

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Drilling: Diamond — Example of Deflecting Diamond-Drill Holes. R. D. Longyear. *Am. Soc. of Petroleum Geol.—Bul.,* Vol. 14, No. 8, August, 1930.

ON PROPERTY on Marquette iron range, Michigan, iron formation overlying ore was so much fractured that exploration had to be undertaken by means of angle holes from either side in more solid ground; curvature was initiated by increasing pressure on bit at desired depth; two of holes were deflected at considerable distance above bottom, in order to explore new ground at depth without re-drilling entire hole.—E.I.S., New York.

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Limestone Mining: Materials Handling—Gasoline Tractors and Trailers in Limestone Mine. J. M. Cox. *Rock Products,* Vol. 33, No. 15, July 19, 1930.

METHODS of handling materials in underground limestone mine of Centropolis Crusher Company, Kansas City, Mo., which produces approximately 12,000 tons per day.—E.I.S., New York.

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Electric Switches — Inclosed Truck-Type High-Voltage Switch Installation for Power Plants in Mines. E. Nattkemper. *Bergbau,* Vol. 43, No. 29, July 17, 1930.

EXPERIENCE shows that inclosed truck-type switches are practical for coal and iron mines; different kinds of switches and installations are discussed.—E.I.S., New York.

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Beryllium Deposits—Beryllium Content of Alleged Beryl Deposits of Koeflach, in Styria. A. Cissarz, H. Schneiderhoehn, and E. Zintl. *Metall und Erz,* Vol. 27, No. 14, July, 1930.

MICROSCOPIC, analytical, and spectro-analytical examination of all typical specimens from Koeflach showed them to be entirely free of beryllium.—E.I.S., New York.

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Boreholes — Present Status of Deep Drilling Technique. P. Stein. *Internationale Bergwirtschaft und Bergtechnik,* Vol. 23, No. 12, June 30, 1930.

EXPLORATORY drilling for minerals; percussive drilling; core drilling and cementing; rotary core drilling; control and correction of crooked holes; geothermal measurement in borehole; drilling for oil; petroleum mining.—E.I.S., New York.

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Classifiers—The Classification of Wet Materials. C. H. S. Tupholme. *Mech. World,* Vol. 88, No. 2279, Sept. 5, 1930.

OUTLINE of prominent devices for screening wet materials; one of best known is Dorr classifier, used for granular products, such as ground quartz, salt crystals, gritty material, finely divided substances, such as earthy materials, chemical precipitates, and paint pigments; and any mixture of finely divided solids and liquid.—E.I.S., New York.

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Gold-Ore Treatment: Cyanidation — Cyanidation of Cupriferous Gold Ores. W. G. Clarke and B. H. Moore. *Chem. Eng. and Min. Rev.,* Vol. 2, No. 262, July, 1930.

REPORT on investigation of tailing from ore treated by battery amalgamation at Gabanitha, near Meekatharra, W. A.; best results were obtained by roasting and amalgamation, followed by agitation for seven hours with cyanide solution; tabular data on extraction.—E.I.S., New York.

Tool Steel—The Development of Modern Drill Steels. R. H. Davis. *Can. Min. Jl.,* Vol. 51, No. 28, July 11, 1930.

ELECTRIC furnace and improved methods of manufacturing ferro-alloys made possible rapid development of alloy steels; analysis of steel is guide to properties which may be expected; proper treatment will develop these properties; discussion of alloying elements; control of melting and processing; use of microscope; mining steel, both solid and hollow, is classed as tool steel; value of research.—E.I.S., New York.

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Kaolin Treatment: Flotation—Preparation of Ceramic Raw Materials by Flotation. H. Kirchberg. *Keramos,* Vol. 9, No. 14, July 16, 1930.

RESULTS of tests treating kaolin by flotation.—E.I.S., New York.

•

Mine Hoists—Hoisting Tower Plant of Koenigsborn Shaft IV. H. Buschmann. *V. D. I. Zeit.,* Vol. 74, No. 32, Aug. 9, 1930.

DETAILED description of coal-mine hoisting tower erected over shaft structure measuring 22 x 33 m.; tower has steel-frame skeleton 16 x 12 by 67 m. high; description of hoisting equipment having useful capacity of 11,700 kg., hoisting speed 16 m. per second; description of electric motors and transformers.—E.I.S., New York.

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Metal Spraying—Sprayed Molten Metal Coating Process and Results. R. L. Binder. *Franklin Inst.—Jl.,* Vol. 210, No. 2, August, 1930.

DEVELOPMENT of invention and explanation of MetaLayeR process of Metals Coating Company of America, Philadelphia, Pa.—E.I.S., New York.

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Mining: Roof Supports—Merits of the Sloan Wire Pack. A. G. Boyden. *Min. and Indus. Mag. of South Africa,* Vol. 10, No. 8, June 11, 1930.

NOTES on increasing use of Sloan wire fencing as containers or retainers for sand filling; comparative costs of Sloan pack, timber pigsty, and concrete pillar form of supports; advantages of Sloan pack over pigsty; unsuitable for steep slope, over 50 deg.—E.I.S., New York.

•

Zinc Metallurgy—Economy of Electrothermal Zinc Production. A. Walter. *Metall und Erz,* Vol. 27, No. 16, August, 1930.

PRACTICAL large-scale application of process by de Laval in Scandinavia; crude zinc and refined zinc recovery; auxiliary plants for refining crude secondary metals; power consumption of electrothermal process in comparison with electrolytic process; suggestion for perfection of both processes.—E.I.S., New York.

•

Microscopes: Metallurgical — New Metallurgical Microscope, Seibert-Metallus. B. Blumenthal. *Giesserei,* Vol. 17, No. 34, Aug. 22, 1930.

DETAILS of microscope and its auxiliary equipment for table or wall projection.—E.I.S., New York.

Rock Drills — Rock Drills With and Without Exhaust. Maercks. *Bergbau,* Vol. 43, No. 27, July 3, 1930.

EXPERIMENTS with rock drills show that drills with exhaust are far more efficient than pure compression drills; exhaust drills showed 31 per cent stronger force in blow than compression drill, and total efficiency increase was 18 per cent; this is because frequency of blows of exhaust drill is lower.—E.I.S., New York.

•

Mine Ventilation—The Reconditioning of Mine Air. A. L. Egan. *Engineering,* Vol. 130, No. 3369, Aug. 8, 1930.

PARTICULAR attention is paid to high- and low-compression machines, with special reference to machine of low-compression type ordered from Brown Boveri for Transvaal mine, having capacity of 3,000 cu.ft. per minute; consists of electric motor taking 236 kw. at 2,000 volts, 50 cycles, running at 2,980 r.p.m. and driving turbo air compressor at 13,900 r.p.m. through single gearing.—E.I.S., New York.

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Mine Cars: Bearings — Bearings for Mine Haulage Trucks. Ostermann. *Bergbau,* Vol. 43, No. 30, July 24, 1930.

DIFFERENT kinds of bearings from plain open journal boxes to high-class ball and roller bearings are discussed; most economical bearings last as long as wheelbase, so that repairs are avoided.—E.I.S., New York.

•

Zinc Ore Treatment—Technical Conditions Governing Zinc Metallurgy in Continuous Systems. H. Cohn. *Metall und Erz,* Vol. 27, No. 14, July, 1930.

GENERAL aspects for operation with vertical muffles; gas density of composite muffle columns; stress of muffle material by slag, temperature change, and metal vapors; description of process of Zinkhuettenwerke, Oberspree, of New Jersey Zinc Company, and Coley process.—E.I.S., New York.

•

Ore Treatment: Classifiers—A Development in Air Classification. G. A. Roalfe. *Rock Products,* Vol. 33, No. 16, Aug. 2, 1930.

SPECIALLY designed device using rising air current for separating flake mica from mica schists; experiments on graphite, cinnabar, gold-bearing quartz, and quartz ore.—E.I.S., New York.

•

Salt Recovery — Salt Recovery From Bulgarian Black Sea Coast. K. Jakubowsky. *Kali,* Vol. 24, Nos. 14 and 15, July 15 and Aug. 1, 1930.

SALT content of Black Sea is about 1.5 to 1.7 per cent; two methods employed for recovery of cooking salt in Bulgaria are described.—E.I.S., New York.

•

Mine Equipment: Prussia — Data on Mining Machinery in Prussian Mining at the End of Calendar Year 1929. *Zeit. fuer das Berg., Huetten-und Salinenwesen,* Vol. 78, No. 2, 1930.

STATISTICAL data on power machinery, excavating, and coal-cutting equipment, arranged by mining districts.—E.I.S., New York.

•

Mine Timber Preservation—Impregnation of Mine Timber. W. Engels. *Revue Universelle des Mines,* Vol. 73, No. 9, May 1, 1930.

MOST efficacious means of combating decay of mine timber consists of impregnating wood, under pressure, with substances that do not allow fungus growth; corrosive sublimate, because of its great toxicity, is not appropriate as mine-timber preservative; impregnation with sodium chloride is equally bad; impregnation with basilit or triolith gives better results as much for their preservative action as for question of economy; effective action lasts at least 20 years.—E.I.S., New York.

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Potash Mining: Germany—Modern Development of Potash Mining, With Special Regard to Concentration of Operations. A. Grumbrecht. *Bergbau,* Vol. 43, No. 17, April 24, 1930.

WORKING of potash mines is described; mining is done with electric rock drills, and draglines are used to haul mined material to shafts.—E.I.S., New York.

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Water Meters — Water Measurement With the Ring Scale. J. Moeller. *Bergbau,* Vol. 43, No. 16, April 17, 1930.

USE OF water meters in mining; meter consisting of combination of diaphragm orifice and circular mercury-filled level is described; example of calculating water volume with this combination is given.—E.I.S., New York.

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Potash Mines and Mining — New Methods of Analysis of Rock Salts and Their Application in Potash Mines With Special Regard to Conditions at Wilhelmshall-Oelsburg, Potash Works. W. Ferling. *Kali,* Vol. 24, Nos. 11, 12 and 13, June 1 and 15, and July 1, 1930.

STRATIGRAPHY of saline beds; tectonic structure; old and new methods of analysis in salt petrography are discussed. (To be continued).—E.I.S., New York.

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Mines and Mining: Labor Conditions—Short Shifts for Hot Working Places. F. Dohmen. *Glueckauf,* Vol. 66, No. 10, March 8, 1930; see also brief translated abstract in *Colliery Eng.,* Vol. 7, No. 76, June 1930.

GERMAN regulations do not permit men to work longer than 6 hours in places where temperature exceeds 28 deg. cent.; if men are engaged only intermittently in high-temperature zones there may be no need to incur increased costs and reduced output involved by shortening working hours; author suggests means of guidance on this point.—E.I.S., New York.

•

Lead-Zinc Ore Treatment: Tasmania—Ore Concentration at the North Mount Farrell Mine, West Tasmania. J. C. Coldham. *Chem. Eng. and Min. Rev.,* Vol. 22, No. 261, June, 1930.

GEOLOGY and ore characteristics; mill started as gravity lead concentrator with primary and secondary jigging and tabling; secondary section reorganized to include fine grinding and preferential flotation of jig tailings and dump residues; capacity 1,400 tons per week; flow sheet and general notes.—E.I.S., New York.

•

Mines: Electric Hazards—Maintenance of Electric Railroads in Mines and Its Influence on Economy and Safety. T. Steinfurth. *Bergbau,* Vol. 43, No. 33, Aug. 14, 1930.

PRECAUTIONS that should be taken to safeguard electric railroads in mines; manner of suspending trolley wires, automatic line switches, signal systems for crossings, current collectors, and rails.—E.I.S. New York.

Mining Geology: South Africa — Geological and Metallogenetic Study of South Africa. A. Demay. *Revue de l'Industrie Minérale,* No. 229, July 1, 1930.

ESSENTIAL elements of geology of South Africa; stratigraphy and eruptive phenomena; study of district of South African Union and Central Rhodesia, and regions further north, including province of Katanga of Belgian Congo; notes on principal deposits of this region, one of richest mining districts of world.—E.I.S., New York.

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Mine Hoists — Latest Koepe Winch Construction to Avoid Rope Slipping. H. Mueller. *Bergbau,* Vol. 43, No. 31, July 31, 1930.

SPECIALLY constructed hoist installation on mine in Germany, to avoid rope slipping; plant is built according to Ohnesorge's patent; hoist has been in operation about one year and has given satisfactory service. —E.I.S., New York.

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Ore Treatment: Waelz Process—Waelz Process for Recovery of Metals. R. Hoffmann. *V. D. I. Zeit,* Vol. 74, No. 30, July 6, 1930.

DEVELOPMENT and operation of process patented by Krupp; detailed data on construction of kiln and economy of process with various ores.—E.I.S., New York.

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Mines and Mining: Pumping—Selection and Operation of Mine Pumping Plants, L. D. Anderson. *Power,* Vol. 72, No. 5 and 6, July 29 and Aug. 5, 1930.

CONSIDERATION of most practicable source or driving power, type of pump and kind of control; how to overcome priming difficulties. Discussion of practical problems that confront engineer in this phase of power service.—E.I.S., New York.

•

Iron Mining: Spain—Present Status of Iron Ore Mining in the Bilbao District. O. Berggren. *Jernkontorets Annaler,* Vol. 114, No. 7, 1930.

GENESIS and development of iron mining in Vizcaya, in Spain; methods and costs of mining iron ore, rubio, and carbonato; roasting furnaces and cost of roasting; quality of ore is declining; present output. —E.I.S., New York.

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Copper Smelting — Slag Losses in the Sudbury District. W. C. Davis. *Can. Min. Jl.,* Vol. 51, No. 28, July 11, 1930.

BRIEF review of general rules governing slag losses in copper smelting; summary of conditions in Sudbury district; converter practices of British American Nickel Corporation; blast-furnace and reverberatory settler losses; slag sampling; slag losses constitute one of principal sources of loss in Sudbury field.—E.I.S., New York.

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Platinum Refining: England—Empire Platinum Refining. *Can. Min. Jl.,* Vol. 51, No. 31, Aug. 8, 1930.

PLATINUM refinery of International Nickel at Acton, near London, to be largest in world; it will treat byproduct of copper and nickel deposits of Sudbury district, and also crude metal from platinum mines of South Africa; flow sheet indicates main operations of refining for concentrates from carbonyl process of Mond plant at Clydach, Wales, and for those from electrolytic process of parent company plant at Port Colborne, Ontario.—E.I.S., New York.

PATENTS

Blasting Cap. No. 1,776,487. Sept. 23, 1930. B. Callas, Helper, Utah.

Design for a blasting-cap protector.

Electrolytic Cell. No. 1,771,984. July 29, 1930. W. G. Allan, Toronto, Canada.

Design for an electrolytic cell.

Classifier. No. 1,777,182. Sept. 30, 1930. E. J. A. Rothelius, Appelviken, Stockholm, Sweden.

Design for a mechanical classifier.

Flotation. No. 1,777,147. Sept. 30, 1930. A. Molander, St. Paul, Minn.

A flotation process consisting of three steps.

Mine Ventilation. No. 1,777,277. Sept. 30, 1930. E. T. Lednum, Butte, Mont.

Apparatus for moistening air for ventilation of mines.

Hoist. No. 1,771,959. July 29, 1930. M. P. Holmes, assignor to Sullivan Machinery Company, Chicago, Ill.

Design for a hoist.

Blasting Machine. No. 1,771,870. July 29, 1930. C. P. Banzhof, assignor to the Fidelity Electric Company, Lancaster, Pa.

Design for an electric blasting machine.

Heating Molten Metals. No. 1,771,918. July 29, 1930. A. Fry, assignor to Fried. Krupp A. G., Essen, Germany.

An electric device for heating molten metals in a ladle.

Container for Molten Metals. No. 1,777,617. Oct. 7, 1930. J. A. Jack, Letchworth, England.

Design for a container for molten metal, lined with ganister intimately mixed with 5 to 25 per cent by weight of carbon.

Crusher. No. 1,775,750. Sept. 16, 1930. D. Cole, assignor to Nordberg Manufacturing Company, Milwaukee, Wis.

Design for a gyratory crusher.

Hot-Metal Ladles. No. 1,776,773. Sept. 30, 1930. F. L. Arensberg, assignor to Vesuvius Crucible Company, Swissvale, Pa.

A protective device for tapping hot-metal ladles.

Grinding Mill. No. 1,777,605. Oct. 7, 1930. E. H. Dimler, assignor to Bethlehem Foundry & Machine Company, Bethlehem, Pa.

A grinding mill, where one of the crushing members has a surface of cobalt-chromium alloy.

Copper Refining. No. 1,776,826. Sept. 30, 1930. H. H. Alexander, Westfield, N. J.

A non-oxidizing atmosphere is maintained above the molten bath, while the copper is subjected to the action of steam under pressure.

Roasting Furnace. No. 1,778,415. Oct. 14, 1930. E. Bracq, Pas de Calais, France.

Design for a mechanical roasting furnace.

Magnesium. No. 1,778,659. Oct. 14, 1930. J. Blumenfeld, assignor to Société de Produits Chimiques des Terres Rares.

Carbonate ores of magnesium are subjected to a chloridizing roast, the magnesium chloride is purified and electrolyzed.

Reduction of Ores. No. 1,777,993. Oct. 7, 1930. H. E. Coley, London, England.

A process for reducing ores by heating the ore to the reducing temperature and injecting an undecomposed hydrocarbon into the body of ore, thereby producing nascent carbon.

Hardening of Copper. No. 1,774,174. Sept. 30, 1930. W. Machin and W. B. Goudielock, assignors to P.M.G. Metal Trust, London, England.

Method of hardening copper and copper alloys by addition of a hardener containing iron, silicon, and copper.

Casting Metals. No. 1,776,355. Sept. 23, 1930. W. F. Eppensteiner, assignor to American Metal Company, New York, N. Y.

Design for a vertical mold for casting metals.

Refining Antimony. No. 1,778,017-20. Oct. 14, 1930. S. G. Blaylock, F. E. Lee, and J. J. Fingland, assignors to Consolidated Mining & Smelting Company, Trail, B. C., Canada.

Separation of gold, silver, and lead from crude antimony by fractional crystallization.

Reduction of Ores. No. 1,775,713. Sept. 16, 1930. T. F. Baily, Alliance, Ohio.

Pulverized ore and coal are dropped through a furnace chamber in opposite direction of a reducing gas. The lower part of the chamber is heated electrically.

Bismuth Refining. No. 1,778,292. Oct. 14, 1930. T. H. Donahue, East Chicago, Ind., assignor of one-half to Cerro de Pasco Copper, New York, N. Y.

Impure bismuth is refined by treating the molten metal with chlorine gas, removing the chlorides formed.

Chloridizing Roast. No. 1,775,767. Sept. 16, 1930. T. P. Holt, Whittier, Calif.

Treatment of ores by a chloridizing roast followed by a hot leach.

Mine Cage. No. 1,776,209. Sept. 16, 1930. G. Weldon, Springs, Transvaal, S. A.

Design for a safety catch for mine cages and skips.

Roasting Furnace. No. 1,778,144. Oct. 14, 1930. G. E. Connolly, assignor to Nichols Copper Company, New York, N. Y.

Arrangement for air-cooling of mechanical roasting furnace.

Mine Doors. No. 1,778,661. Oct. 14, 1930. L. B. Childe and A. G. Kershaw, assignors to Union Switch & Signal Company, Swissdale, Pa.

Device for control of mine doors.

Cathode-Loading Machine. No. 1,776,617. Sept. 23, 1930. W. T. Burns, Plainfield, N. J.

Machine for loading cathodes on car.

Electric Refining Furnace. No. 1,778,578. Oct. 14, 1930. T. F. Baily, Alliance, Ohio.

Design for a resistance-type furnace for refining metals.

Safety Hat. No. 1,776,249. Sept. 23, 1930. E. W. Bullard, San Francisco, Calif.

Design for a safety hat with visor and crown of non-conducting material.

DRILLS

Drill Steel. No. 1,776,594. Sept. 23, 1930. J. F. Mock, assignor to Ingersoll-Rand Company, Jersey City, N. J.

Design for a centralizer for drill steels.

Rock Drill. No. 1,778,553. Oct. 14, 1930. E. G. Gartin, assignor to Sullivan Machinery Company, Chicago, Ill.

Design for a drifting drill.

Rock Drill. No. 1,774,482. Aug. 26, 1930. E. G. Gartin, assignor to Sullivan Machinery Company, Chicago, Ill.

Design for a rock-drilling mechanism.

Rock Drill. No. 1,771,868. July 29, 1930. R. H. Wilhelm, assignor to Ingersoll-Rand Company, Jersey City, N. J.

Design for the valve on a rock drill.

Rock Drill. No. 1,776,509. Sept. 23, 1930. G. W. Hulshizer, assignor to Ingersoll-Rand Company, Jersey City, N. J.

Design for a rotating mechanism for rock drills.

Rock Drill. No. 1,776,521. Sept. 23, 1930. W. A. Smith, Sr. and W. A. Smith, Jr., assignors to Ingersoll-Rand Company, Jersey City, N. J.

Design for a pile-driver attachment for rock drills.

Rock Drills. No. 1,776,273. Sept. 23, 1930. W. A. Smith, Jr., assignor to Ingersoll-Rand Company, Jersey City, N. J.

Design for a rock-drill valve.

Rock Drills. No. 1,776,604. Sept. 23, 1930. W. A. Smith, Sr. and J. C. Curtis, assignors to Ingersoll-Rand Company, Jersey City, N. J.

Design for blowing device for rock drills.

Rock Drills. No. 1,777,306. Oct. 7, 1930. D. W. Hart, assignor to Ingersoll-Rand Company, Jersey City, N. J.

Design for shank and bit punch.

Rock Drills. No. 1,777,334-36. Oct. 7, 1930. W. A. Smith, Jr., assignor to Ingersoll-Rand Company, Jersey City, N. J.

Design for valve for rock drills.

Rock Drills. No. 1,777,775. Oct. 7, 1930. W. A. Smith, Jr., assignor to Ingersoll-Rand Company, Jersey City, N. J.

Design for valve for rock drills.

Comment and Criticism

Bimetallism and the Price of Silver

To the Editor of "E.&M.J.":

Referring to the editorial in the issue of May 8, 1930, I note the statement that "This publication . . . would willingly lend support to any legislation that would in its opinion really foster the interests of the silver miner." I have been familiar with and connected with the silver industry since the early 'sixties, having spent 30 years in Nevada, from 1875 to 1905. I was born in California in 1854, and have a fairly good idea of the matter from actual experience and observation. I am inclosing for your examination a copy of a monograph entitled "Gold and Silver," in the nature of a letter to Senator Key Pittman dated Aug. 19, 1930, which contains my views of the matter and the course which should be pursued, in my opinion. I also inclose copies of letters to Señor Ortiz Rubio, President of Mexico, and his answer; also copy of correspondence with Mr. P. C. Denroche, one of the best posted men in the China and Oriental trade, of many years' experience; also copy of letter sent to the governors of states and to presidents of railroads. It has been presented to President Hoover.

2821 Woolsey St., Berkeley, Calif. S. A. KNAPP.

Mr. Knapp's monograph and the correspondence referred to, in mimeographed form, have been read with interest, and copies are doubtless available to those who wish to make a detailed study of the analyses and proposals and who will apply direct to him at the above address. Limitations of space prevent the reproduction of the monograph and correspondence in these pages. The recommendations, which, according to a statement that forms an appendix to the monograph, have met with the "warm approval" of Dr. T. A. Rickard, may be summarized as follows:

"One of the principal things to be accomplished . . . is to restore silver to its rightful place as a primary hard money of redemption at the ratio of 16 to 1 with gold in all the principal countries of the world. . . . The first step should be taken by levying an import tax on foreign silver of 30c. per ounce or more, after that allowing the coinage of silver produced from United States mines at a ratio of 16 to 1 of silver and gold produced, silver coin so produced to be paid to the depositor of the silver bullion, any gold contained in silver bullion to be paid in gold coin. Second, raise the legal tender limit on silver to $20 until agreement is reached with other countries."

Recapitulated, the recommendations and advantages claimed are:

"First: Recognizing silver as primary money.

"Second: Establishing the ratio between silver and gold at 16 to 1, our present coinage ratio in this country.

"Third: By coining to 50c., 25c., and 10c. pieces, giving our people convenient sized coins for small transactions.

"Fourth: Doing away with unsanitary paper money will reduce the danger of a spread of disease.

"Fifth: Reduce the loss by fire.

"Sixth: Reduce the danger of loss by counterfeiting.

"Seventh: Reduce the expense of printing paper money.

"Eighth: Assist the miners of gold, copper, lead, zinc by giving them full value payable in silver coin for the silver byproduct produced in mining the other metals, thus decreasing the cost of same.

"Ninth: Giving notice to the world that the United States recognizes silver as a primary money at a fixed ratio within its own boundaries and invites other countries to do the same, thus increasing the domestic use of silver in all countries, relieving the strain on gold and the danger of its going to a premium."

■

The Price of Gold

To the Editor of "E.&M.J.":

Your editorial of Sept. 8, on Mr. Ford and the ten-month working year, provokes discussion.

No machine can do as much work in five days as it can in six, and neither can a laborer, although most laborers could perform more work daily and weekly without physical injury.

The United States produces more than it can consume. If not, there would be no reason for advocating fewer working days in the year.

If this country lived in isolation from the rest of the world, and did no business with foreign countries, we would need no surplus of goods, machines and agricultural products, to exchange for rubber, spices, tea, coffee, and other commodities. But, even then, farming and business could not be regulated to prevent a surplus at times in many things. We need a foreign market where the surplus can be sold, and to sell such produce abroad we must meet foreign competition.

The labor cost is the principal cost in everything we use, no matter whether it be lumber, stone, steel, grain, minerals, goods, tools, or machinery. The higher the wages along the line, the greater the cost to the purchaser. When farm produce, goods, or machinery can be produced abundantly and cheaper abroad than here, then we shall lose our foreign market.

For years we have been able to meet competition through our more liberal use of power and machines. Now, thanks to Henry Ford and to other capitalists, we will soon meet severe competition. The millions of American money going into Europe to install electric power and to build up-to-date, well-equipped manufacturing plants will enable the foreigners to produce more cheaply than shops in the United States. Ford can sell and ship to South America from Europe more cheaply than from the United States. If all of his automobiles were built here, we would have less unemployment, and other American industries would be helped.

Asia used to import all cotton goods from England and from the United States. Now the cotton mills in China, built and owned by American and English capital, can supply the Asiatic demand.

We are on a gold basis, but the value of an ounce of gold measured in wages and in commodities is bound to increase. Either there will be a general deflation from War prices, or prices can remain as they are by making an ounce of gold worth more U. S. dollars. The latter course would be quicker and less painful for the majority of the people, but would not be popular with the bankers.

The law of supply and demand governs prices. The demand for gold will continue, but the supply will decrease.

Mr. Kursell, in an able article in the September issue of the *Mining Congress Journal*, on "Gold Production and Its Future," states the decrease in production will be slow until about 1935, but that between 1935 and 1940 there will not be available for banking and for currency more than 5,000,000 to 6,000,000 oz. annually, or about half of what is available at present.

The United States has a large gold supply, and it would be well for Uncle Sam to anticipate and to raise the price of gold in dollars, so as to keep the price of wages, farm land and commodities as they are, measured in U. S. currency, rather than to revert to prices as they were before the World War.

Land in the corn belt, worth $50 per acre before the War, was sold at $200 and more per acre during the War. The sellers moved to Los Angeles, and the buyers are now calling for farm relief, as they cannot make a fair return on their investment. ALBION S. HOWE.

Sutter Creek, Calif.

New Publications

MINERAL RESOURCES OF THE UNITED STATES, 1926. *U. S. Bureau of Mines. For sale by Superintendent of Documents, Washington, D. C. Part 1, Metals, price $1.25; Part 2, Non-Metals, price $1.*

The separate chapters of these books have been issued previously, but it is to be regretted that more speed cannot be exhibited in the publication of the bound volumes. All of the more important mineral products of the United States are statistically covered, and for some of them considerable detail is given covering occurrences, operating activities, marketing, and the development of consumptive demand. Particularly valuable are the lists of names of producers, dealers, and consumers, appended to some of the chapters.

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THE METALLURGISTS AND CHEMISTS' HANDBOOK. THIRD EDITION. *By Donald M. Liddell. New York: McGraw-Hill Book Company. Pp. 847. Price $5.*

Changes and improvements in metallurgy since 1918, when the second edition was issued, have necessitated revision and enlargement of this useful handbook, but the old convenient pocket size is still retained. Many editions have been made to the chapters on ore dressing, cyanidation, fuel and refractories, and general metallurgy. Special mention must be made of the chapter on flotation and the revised table on alloys.

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MILLING METHODS, 1930. *New York: A.I.M.E., 29 West 39th St. Pp. 554. Price $5.*

Papers and discussions presented at Institute meetings held in New York, February, 1928, 1929, 1930; at San Francisco, October, 1929, and at Spokane, October, 1929, are published in this volume. Seven are on grinding and classification; one paper is on gravity concentration; seven papers are on flotation; three on testing and calculation and two on cyanidation. The authors of the papers presented are: Leon M. Banks, L. M. Barker, E. Bierbrauer, A. B. Campbell, W. H. Coghill, J. V. N. Dorr, A. W. Fahrenwald, A. M. Gow, John Gross, A. M. Gaudin, William C. Hunter, C. R. Ince, George A. Johnson, C. R. King, L. Klein, A. F. Knoll, C. W. Lawr, E. S. Leaver, R. L. Lechmere-Oertel, W. Luyken, A. D. Marriott, H. S. Martin, F. N. Miller, T. F. Mitchell, O. C. Ralston, A. F. Taggart, T. C. Taylor, F. X. Tartaron, J. A. Woolf, O. E. Young, and S. R. Zimmerley.

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YEAR BOOK OF THE AMERICAN BUREAU OF METAL STATISTICS. *Tenth annual issue; 1929. New York: American Bureau of Metal Statistics, 33 Rector St. Pp. 117. Price $2.*

The latest edition of this comprehensive year book, containing data on all of the more important non-ferrous metals, fully lives up to the standard that has been maintained from year to year. The chief improvement this year is in more complete explanation of the various tables, so that they can be interpreted properly. In general, the information given relates to production, consumption, imports and exports, prices, lists of important companies, and related items, the metals covered being copper, lead, and zinc in some detail, with less completed data on gold, silver, platinum, antimony, arsenic, nickel, cadmium, tin, iron and steel, and aluminum.

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CHEMICAL ENGINEERING CATALOG. *Fifteenth Annual Edition. New York: Chemical Catalog Company. Pp. 1168. Price $10. Free to executives, laboratories, libraries and colleges.*

This catalog contains condensed data on equipment, machinery, laboratory supplies, and heavy and fine chemicals, with classified indexes, carefully cross-referenced, compiled with the co-operation of 600 manufacturers. A technical and scientific book section, cataloging and describing briefly books on chemical and related subjects, should be of assistance to the technical reader.

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SIMPLE GEOLOGICAL STRUCTURES. *By John L. Platt and John Challinor. D. Van Nostrand Company, 8 Warren St., New York. Pages 56. Price $1.35.*

A series of notes and map exercises prepared by the authors, who are lecturers in geology in the University College of Wales, at Aberystwyth. The object is to make clear the elementary but essential principles concerning the reading of simple geological structures, and their implications from a simple geological map. In addition, a series of illustrative map exercises are worked out and explained.

KEYSTONE METAL QUARRY CATALOG, 1930. *McGraw-Hill Catalog and Directory Company, 475 Tenth Ave., New York. Pages 434. Price $15.*

This collection of catalogs, which incidentally is a tenth edition, has been brought together to make it easy for those engaged in metal mining and quarrying to determine the types of products made by manufacturers supplying their fields, as well as to ascertain how the facilities of these manufacturers, from the production and distribution standpoint, can help in carrying out mining and quarrying projects. An effort has been made to bring together such data as will be really useful and time-saving. The volume is divided into three parts: Catalogs, with index by company name, pages 8-346; index to products catalogued, with company names, pages 347-378; and tabulated buying data, with index, pages 374-434.

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HANDBOOK OF CHEMISTRY AND PHYSICS, 14TH EDITION. *By Charles D. Hodgman and Norbert A. Lange. Cleveland, Ohio: Chemical Rubber Publishing Company. Pp. 1386. Price $5.*

A large variety of material appears for the first time in this edition, such as a revised table of the density of the elements, a much enlarged table on the physical constants of common minerals, special tables on conversion of thermometer scales, and a large number of other new physical, chemical, and mathematical tables. Mention should also be made of several pages of equations of representative qualitative volumetric reactions with gravimetric equivalents.

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HYDROGEN IONS. *By Hubert T. S. Britton. New York: D. Van Nostrand Company, Inc. Pp. 515. Price $9.*

This is the third volume of a series of monographs on applied chemistry, under the editorship of Dr. E. Howard Tripp. This book contains a scientific discourse on the hydrogen ion, and it also provides a practical discussion of the various electrometric and colorimetric methods of its determination, with discussion of the apparatus used for this purpose. The fundamental importance of this factor in general chemistry is shown, and its utilization in analytical chemistry. Finally, applications in industrial chemistry and hydrometallurgy have been discussed, with brief outline of the processes involved.

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INDUSTRIAL PROGRESS

An Automatic Battery-Charging Panel

F. A. RANK
General Electric Company
Salt Lake City, Utah

The new panel

THE Bingham mine of the United States Smelting, Refining & Mining Company operates three storage-battery locomotives on three different levels of the mine. It recently purchased a new motor-generator set and charging panel for charging the batteries. A set was wanted which would be fully automatic.

The fully automatic panel was designed in Salt Lake City and was erected in the local General Electric service shop. The accompanying photograph shows the front view of the panel and the diagram shows the wiring. With this arrangement it was only necessary for the company to run two wires from the charging panel down the shaft to the various levels and to install a charging receptacle at each level.

Referring to the accompanying sketch, the scheme of operation is as follows: The circuit breaker *A* is closed the first time by hand, and remains closed thereafter unless tripped by overload or reverse current. It was considered best to have this reset manually, as under normal conditions it will not open, and if opened by either overload or reverse current, an attendant should inspect it and find the cause of trouble.

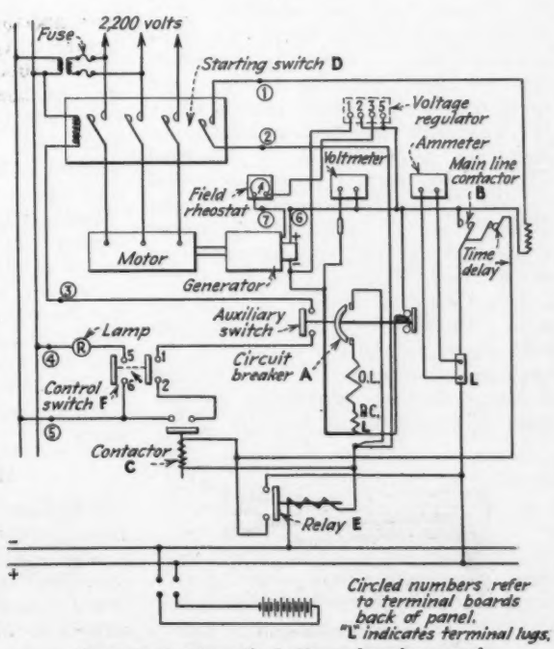
When the first locomotive is plugged in, the current from the battery flows through the interlock on the main-line contactor, *B* (which opens after a time-delay and closes instantaneously), through the coil of the contactor *C*, closing its contact, which in turn completes the operating circuit of the motor starting switch *D*, thus starting the motor-generator set.

The interlock on the switch *D* is in series with the coil of main contactor *B*, so that, on closing, this coil is connected across the generator terminals and the contactor will close when the generator voltage builds up, thereby completing the charging circuit through the instantaneous relay *E*. The contacts of relay *E* are in parallel with the time-delay interlock on contactor *B* and form the holding circuit of contactor *C*. The interlock on contactor *B* is made instantaneous closing and time-delay opening in order that the relay *E* may close its contacts before the interlock opens.

All the locomotives are equipped with ampere-hour meters and have shunt-trip circuit breakers, so that when the batteries are fully charged they trip off at the locomotive itself. When the last one trips off, no current is flowing in relay *E*, which opens its contacts and shuts down the motor-generator set.

If the power goes off during the charge, switch *D* will drop out, opening the main d.c. contactor. When the power comes back on, the set will start again and resume charging.

A control switch, *F*, is installed, so that the set can be shut down when desired for repairs; also a red light, so that anyone can tell if the machine is in position to charge.



Layout of automatic battery charging panel

Equipment Developments —A Summary

AT THE next Power Show, or, to be more exact, the National Exposition of Power and Mechanical Engineering, to be held in New York on Dec. 1-6, the cunning of the inventor in devising electrical control of all kinds will be displayed. Guesswork in handling large plants is expensive and electrical devices are cheap and accurate. The exhibits will demonstrate what can be done to get maximum efficiency in power production and will indicate what the near-by future has in store. There will be no Power Show in 1931, so maximum effort will be made to make the forthcoming one a success.

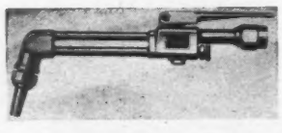
In the meantime, manufacturers are not waiting for the Show. *General Electric* has announced a new type of equipment—the audible selector supervisory equipment—for controlling from a remote point by means of audio-frequency impulses such automatic electric devices as are to be found in automatic hydro-electric generating plants, automatic pumping stations, and the like. Valves and circuit breakers can be opened and closed, pumps started and stopped, and information as to conditions on the line be automatically obtained. Audible signals are given by means of a howler. A minimum of equipment is used and only two line wires. Open line wires paralleling high-tension power lines may be used. . . . For measuring the kilovolt-ampere demand in connection with the analysis of loads, the *Sangamo Electric Company*, Springfield, Ill., has designed a kilovolt-ampere demand meter (Type S). This is an auxiliary device controlled by two watt-hour meters, measuring the energy and reactive component, to give, on a single chart, the following information relative to the load: the kilovolt-ampere demand, kilowatt demand, maximum kilowatt demand, power factor at time of demand, reactive component demand, the time

A precise electrically operated time switch

that the demand occurred, the energy component in kilowatt-hours, and the reactive component in reactive kilovolt-ampere-hours. This meter can be built for 50- or 60-cycle operation. . . . The difficulty of mounting pressure and flow instruments of the manometer type in a neat and compact manner on control panels is said to have been overcome by the *Meriam Company,* Cleveland, Ohio, in an instrument developed for indicating high forced draft conditions in a certain power plant. This is a combination-type multiple manometer, which measures forced draft at the fire box, draft at the fire arch, and draft at the stack outlet. . . . In the control mechanism of a new indicating pyrometer controller, the use of mercury contacts for breaking high currents has been incorporated by the *Brown Instrument Company,* Philadelphia, as a new feature of design. This controller can be supplied as an automatic pyrometer, a resistance thermometer, a tachometer, or a CO_2 meter. . . . Mercury contacts are also used in a new float switch (CR-2931-U) developed by *General Electric* for use in atmospheres where open-type, mechanical contacts might be subject to corrosion, or where, for other reasons, it is desirable to inclose the contacts totally. This type of contact makes the device suitable also for heavy duty, so that it can be used for throwing motors directly on the line up to certain capacities. This mercury switch is known as a "Konnector." It consists of a hard glass envelope containing a quantity of mercury and having two inleading wires. When the switch is in the closed position, the mercury forms a continuous stream from one wire to the other. The envelope is filled with an inert gas. . . . The timing requirements of any electrically controlled work cycle may be met, it is said, by a so-called "work-cycle timer" designed by the *Monitor Controller Company,* Baltimore, Md. This timer will start, stop, accelerate, decelerate, reverse, heat, cool, open, close, raise, lower—in short, do anything that can be done by electricity. Its most important characteristic is that it can be reset instantly at the starting point at any time during or after the completion of the cycle. . . . A new time switch for which high precision and quality of manufacture are claimed has been recently introduced by the *Sangamo Electric Company,* Springfield, Ill. Essentially it is the Hamilton-Sangamo electrically wound clock, arranged to trip a mercury switch. It may be had for any commercial voltage or frequency, a.c. or d.c. . . . Compensating features which practically eliminate ratio and phase-angle errors have been incorporated in a new type of instrument current transformer (WF-I) by *General Electric.* This is built in ratings from 5 to 800 amp. and is designed for 5,000-volt operation. It is used for connecting watt-hour meters, instruments and relays, where the combined burden does not exceed 50 volt-amperes. It has practically straight-line accuracy down to 5 per cent load.

Of general interest as a measuring device is a new type of vacuum tube developed by *General Electric.* With it can be measured, it is said, a hundredth of a millionth of a billionth of an ampere. It is said to measure accurately a flow of about 63 electrons a second. It is expected to replace electrometers in the measurement of small currents. It is more sensitive and is more easily mounted. . . . A very different type of instrument from devices thus far considered is the engine indicator, which serves as a guide in safeguarding engine performance, by giving a graphic record of the pressures inside the cylinder while the engine is running. Recent developments in its line of Maihak indicators have been announced by the *Bacharach Industrial Instrument Company,* Pittsburgh.

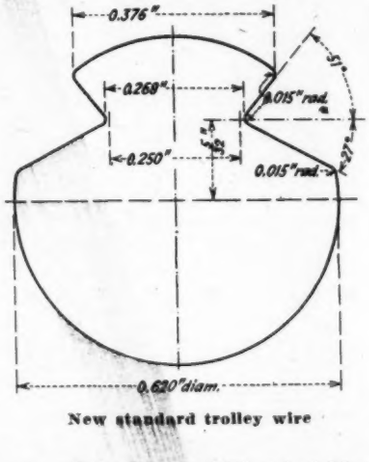
Where motors are manually controlled, because of infrequency of operation or for other reasons, and it is desired to have the complete control of the primary and the secondary of a wound-rotor induction motor in a single compact unit, a line of manually operated non-reversing starters and speed regulators, recently introduced by *Westinghouse,* may be found desirable. Reference is made to the so-called Class 12-600 control panels, described in detail in the company's leaflet 20,486. . . . To facilitate the proper lubrication of ball and roller-bearing motors, *General Electric* has introduced a grease which is supplied in tubes and cans. The tube is calibrated into one-half ounces to assist in measuring the amounts recommended. This lubricant is being used on ball-bearing applications with speeds as high as 25,000 r.p.m. and temperatures from minus 25 deg. to 250 deg. F.



A cutting attachment for welding

Welding equipment recently introduced includes some new accessories for the Type W-17 welding blowpipe previously brought out by the *Oxweld Acetylene Company,* New York. These include a new cutting attachment, which enables the blowpipe to do a reasonably wide range of cutting work. Another accessory is a welding head adaptor which makes it possible to use the blowpipe for work ranging from the lightest to heavy general work. . . . *General Electric* has brought out an improved portable, semi-automatic arc-welding equipment which can be used for either open or shielded arc welding. Conversion can be effected in a few minutes.

Approval of the American standard "insulator tests and ratings" has been announced by the *American Standards Association.* This standard covers insulators for power lines for voltages exceeding 750 volts. It was developed under the joint sponsorship of the American Institute of Electrical Engineers and the National Electrical Manufacturers Association. . . . A new type of rubber insulation, called "Anoroc," has been announced by the *Simplex Wire and Cable Company,* Boston. It does away with corona and ozone troubles on high-voltage cables insulated with rubber compounds.



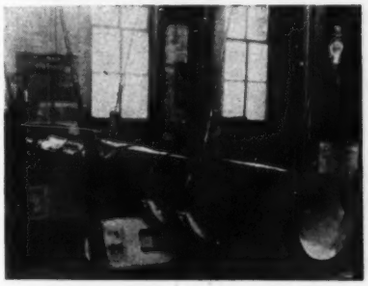
New standard trolley wire

Demand for a trolley wire of heavier section than the 4/0 size regularly used in the past has led to the development of a new standard section shown in the illustration, the *National Electrical Manufacturers Association* announces. The top lobe is like that of the 4/0 wire, so that trolley clamps and ears are interchangeable. The wire is shown above.

Material Handling

Handling of hot materials presents special problems. The introduction of a water-jacket to the tubular vibrator conveyor, announced by *Traylor Vibrator Company,* Denver, Colo., is of interest to all smelter operators. Cold water, under pressure, is injected at the

lower rear end of the tube and circulates the length of the tube. The warm water then travels back along the top side of the tube and is released through a valve on the top rear end. With this water-cooled tube it is possible to handle material up to 2,000 deg. F. with a marked cooling taking place in a tube 12 ft. long. The tube can be operated as steep as 18 deg. uphill without materially decreasing the capacity. Operating under full load, the conveyor requires less than three-quarters of a horsepower. It takes any standard alternating current. With each unit a small motor generator set is furnished, so that the operator has



This tubular vibrating conveyor is water-jacketed

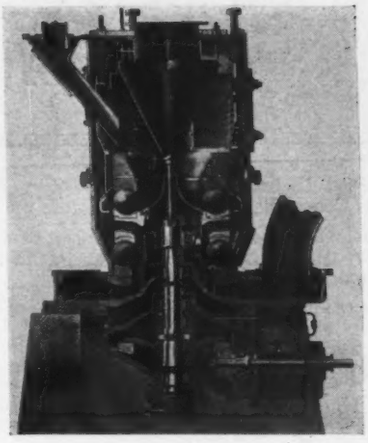
a positive rheostat control over the amplitude of the vibration. Speed of travel of the material can be varied from 50 ft. a minute to zero by a rheostat. These conveyors are furnished without coolers in open launder type as well as tubular. The tubes range in diameter from 10 in. to 26 in. and are furnished in any length necessary. The pan type or open launder types are furnished in widths ranging from 10 in. to 48 in. and in any length necessary to accomplish the duty. These conveyors are capable of handling up to 200 tons an hour. . . . A new roller-bearing belt-conveyor carrier, known as the "Pacific type," has just been developed by the *Stephens-Adamson Manufacturing Company,* Aurora, Ill. Timken bearings are used throughout, and the carrier is featured for use wherever a high-grade conveyor of medium price is wanted. It is built in sizes for conveyor belts 18 to 48 in. wide. It is of the three-roller, 20-deg. trough design now favored by most engineers. The construction is of heavy-gage pressed steel, with the single exception of the end-stand castings, making the carrier light in weight, strong, rigid, and practically unbreakable. Every roller, with its bearings, shaft, and grease seals, is a self-contained unit that can easily be interchanged with any other roller without disturbing the bearing adjustment. . . . Standard sizes of "Durolite" dragline blocks, made by *Sauerman Bros.,* Chicago, formerly started with the 12-in. unit. Since these were introduced, 10- and 8-in. blocks have been added to the line, and recently a still smaller block with only 6-in. sheave diameter has been brought out, these smaller sizes being designed particularly for underground mines and other situations where close quarters and frequent handling make minimum of weight the prime requirement. The 6-in. block recently developed lacks the open construction of the housing that is a feature of the larger blocks, but in other respects is the same as the others. It is shown in a cut.

A light new 6-in block

A patented self-vulcanizing rubber compound, intended for resurfacing conveyor belts, for covering pipes, shafts, and the like, as well as for lining chutes, hoppers, agitators, and other receptacles, has been developed by the *Hitchcock Company,* 48 Pearl St., Boston. It is known as "Covulc," is soft and plastic, is red, gray, or black in color, and has exceptional toughness and resistance to abrasion. Applied as a thick paste, it rapidly vulcanizes when exposed to air and forms a permanent rubber covering on any surface to which it is attached. After vulcanizing, it remains soft and flexible during its life and does not harden, the manufacturer claims. It may be had either in the form of paste or in sheets already vulcanized to a wire-mesh base. In the latter form it can be cut to any size desired and used for lining.

Pulverizing and Separating

Progress made in burning pulverized fuel has caused the *Fuller Lehigh Company,* Fullerton, Pa., to develop a more efficient pulverizer, which the company has recently introduced as the Type B machine. This is an air-separation ball mill, which retains all the desirable features of the Lehigh mill. Pressure between balls and grinding ring is maintained independently of mill speed. The machine has three sections: a top, or separator section, an intermediate or pulverizing section, and a base or drive section. Grinding elements consist essentially of two rows of large-diameter balls, and two stationary rings and one rotating grinding ring. The rows of balls are mounted one above the other and are separated and propelled by the rotating ring, which is driven by and floats on the main driving shaft. The rings are made to gage, to insure interchangeability. Grinding pressure is applied and kept uniform by externally controlled steel springs mounted in the top section. In operation, raw coal crushed to pass a ¾-in. ring is fed by a drag feeder from an overhead bunker, then dropping through the feed spout onto a rotating cone inside the upper row of grinding balls, whence it is



An air-separation ball mill for pulverizing fuel

thrown outward into the path of the grinding balls by the centrifugal action of the cone. When ground fine enough here, it passes through the annular opening formed by the intermediate grinding ring and the coal basket. It now encounters currents of preheated air that enter an air-distributing chamber in the base and are discharged through openings in the intermediate ring. Fines are carried upward by the air stream, and the coarse particles fall into the lower row of balls for further grinding. Here they are ground until fine enough to be removed by the action of the air currents. In this mill, fineness is controlled by regulating the air flow and varying the position of the adjustable sleeve inside the classifying zone. The mill is generally adjusted to obtain a fineness of 65-70 per cent through a 200-mesh screen and not over 2 per cent plus 50-mesh. This latter degree of fineness meets the requirements of efficient combustion satisfactorily. The pulverizer is shown in an accompanying cut.

In the Explosives Field

Burton Explosives, Inc., has bought a tract of land near New Castle, Pa., on which it will erect a chemical and explosives manufacturing plant. Previously, this company has been a sales organization. The new plant will start Jan. 1, 1931, with an initial capacity of 12,000,000 lb. of high explosives.

FIRST AID MATERIALS. Mine Safety Appliances Company, Pittsburgh, Pa. Catalog No. FA-2. A 36-page catalog, profusely illustrated and covering the complete line of first-aid materials manufactured by this company for industrial and mining use. Its completeness is illustrated by the fact that it contains such items as poison ivy treatments, auto kits, hot pads, mercuro-compresses, and bandages. Copies will be furnished gratis to those interested in such work.

Personal Notes

P. C. Schraps sailed from New York for Venezuela on Oct. 15.

E. G. Howe is now on the staff of Real del Monte y Pachuca, at Pachuca, Hidalgo, Mexico.

Arthur E. Hepburn, consulting engineer, of Denver, Colo., is in New York on a short business trip.

Albert J. Anderson has been appointed general manager of New Goldfields of Venezuela at Roscio, State of Bolivar, Venezuela.

Arthur Thacher, of St. Louis, Mo., has made a satisfactory recovery from a recent serious operation, and is rapidly regaining health.

H. C. Dudley, of Duluth, Minn., president of Cusi Mexicana Mining, paid a recent vist to his company's property in Chihuahua, Mexico.

C. A. Lantz has resigned the management of the Santa Gertrudis mines, at Pachuca, Hidalgo, Mexico, and will make his home in California.

S. Power Warren, on leave from the Colorado School of Mines, has enrolled at Queen's University, Kingston, Ont., for work toward the degree of M.Sc.

Philip D. Wilson has returned to New York after several months in Mexico, and will make his headquarters at the offices of the American Metal Company, Ltd.

W. H. Bassett, president of the A.I.M.E., was the principal speaker at a dinner given in his honor by the Globe-Miami section of the Institute at Jerome, Ariz., on Oct. 8.

Dr. **Scott Turner,** director of the U. S. Bureau of Mines, was recently given the honorary degree of Doctor of Engineering by the University of Michigan, of which institution he is a graduate.

B. Marcuse, president of the Canadian Asbestos Company, has an interesting and well-illustrated article, entitled "Asbestos—'Pierre à Coton,'" in the October issue of the Canadian Geographical Journal.

Walter Eaton, superintendent of La Rica unit of Real del Monte y Pachuca, at Pachuca, Hidalgo, Mexico, has resigned to accept the position of general superintendent of the Patiño mines at Llallagua, Bolivia.

A. Chester Beatty has returned to London after having examined the Trepca mine and other Serbian properties of Selection Trust. He was recently elected to the board of directors of American Metal.

C. L. Colburn, mining engineer, of Denver, Colo., and secretary of the Colorado Mine Operators' Association, was recently in San Francisco, where he attended a luncheon given by Colorado School of Mines alumni.

C. F. Burt, until recently mine superintendent at the Dolores unit of American Smelting & Refining, at Matehuala, San Luis Potosí, Mexico, is now with New York & Honduras Rosario, San Juancito, Honduras, in a similar capacity.

C. V. Brennan has been appointed assistant general manager of Britannia Mining & Smelting and its subsidiaries. **E. F. Emmons,** formerly assistant to Mr. Brennan, succeeds him as superintendent at the Britannia mine, Britannia, B. C.

George Lyman, assistant underground superintendent for Copper Queen Mining at Bisbee, Ariz., who recently underwent a major operation at the Copper Queen hospital, has recovered sufficiently to leave that institution for his home.

R. W. Stone, Assistant State Geologist of Pennsylvania, and **F. H. Wood,** of Harrisburg, Pa., sailed from New York on Oct. 11, for Colombia, where they will be engaged in geologic and engineering work near Bogota for about six weeks.

C. W. Traughber, metallurgist and fume expert for the Dust Recovering & Conveying Company, Cleveland, Ohio, has sailed for Sardinia, accompanied by his wife. He will spend a few weeks in a consulting capacity at the plant of Soc. di Montiponi, at Montiponi.

Robert Handley, mining engineer for Union Minière, at Katanga, in the Belgian Congo, with Mrs. Handley, is visiting several mining districts in the United States before returning to Africa. Early in October they were in Jerome, Ariz., visiting Dr. and Mrs. L. E. Reber.

Dr. **F. R. Moulton,** at a recent meeting of the American Astronomical Society, averred that the meteor crater near Winslow, Ariz., is probably only a remnant of a vast mass of meteoric material. The possibility of finding any larger deposit than that disclosed to date is slight, according to Doctor Moulton, who claims that an immense meteor would encounter enormous resistance on impact with the earth, resulting in its almost complete destruction.

H. H. Schuette and **H. Alder,** of the University of Wisconsin and the Wisconsin Geological and Natural History Survey, have recently completed interesting researches on the origin of limestone. Analyses of an aquatic weed (*Chara*) indicate that it absorbs large quantities of calcium carbonate from the water in which it grows. The reserves of calcium carbonate at the bottom of one shallow lake were shown to be augmented at the rate of about 1,000 tons per annum from this source.

Dr. **John W. Finch,** dean of the University of Idaho school of mines, has accepted the chairmanship of an editorial committee of geologists who will supervise the writing of a memorial volume on the ore deposits of the Rocky Mountain region. The volume will be published in honor of Dr. **Waldemar Lindgren,** who is about to retire from teaching at the Massachusetts Institute of Technology at the age of 70. It will set forth the progress which has been made in the knowledge of ore deposits since Doctor Lindgren began his active field work a half century ago, and will emphasize the fact that the progress made is due in a large measure to Doctor Lindgren himself. Sponsoring the book are the Society of Economic Geologists and the A.I.M.E. It will be financed by the latter society from funds donated by the old Rocky Mountain Club, of New York. The book is to be ready by 1932 as a contribution to the International Geological Congress to be held in this country in that year.

OBITUARY

Charles M. Baillie, of Wallace, Idaho, pioneer prospector and owner of several properties in the Coeur d'Alene district, was killed when struck by a train near Wallace, on Oct. 3. He was about 65 years old, and had been a resident of the district since 1885.

J. H. Cassidy, pioneer miner of the Globe-Miami district, died at Globe, Ariz., recently, after a long illness. He was born in Altoona, Pa., in 1866, and had lived in Globe for 30 years. He was at one time mine foreman for Iron Cap Copper.

J. H. Hirt, mining engineer and metallurgist, of El Paso, died on Sept. 14, of apoplexy. Mr. Hirt was a native of Belgium, having come to this country at the age of 14, in 1880. He was a graduate of the Massachusetts Institute of Technology.

W. I. Snyder, vice-president and general counsel for Tintic Standard Mining, died at his home in Salt Lake City on Oct. 3. He was born near Salt Lake City 74 years ago, and practiced law in Park City until 1901, when he moved to Salt Lake. He was the author of "Snyder on Mines."

J. Dawson Hawkins, of Colorado Springs, Colo., died on Oct. 14, after a long illness. Mr. Hawkins, who was a graduate of Pennsylvania University, had been connected in a metallurgical capacity with several Colorado mining companies. He was 62 years old, and is survived by his widow and two children.

Earl Gaskill, of Red Bank, N. J., was drowned near Barnegat Inlet, N. J., on Oct. 11. Mr. Gaskill, who was 35 years of age, had been with St. Joseph Lead for four years, and had developed for the company the process for the manufacture of zinc oxide which is to be used at the new plant now under construction at Josephtown, Pa.

Charles L. Denison, president of Teck-Hughes Gold Mines, Ltd., died at his home in Saddle River, N. J., on Oct. 8, after a long illness. He was chiefly responsible for the success of the Teck-Hughes property, which he backed against adverse advice and through several years of extreme financial difficulties. His first mining experience was in the coal-mining industry in the United States. While on a fishing trip he bought the Buffalo claim in the Cobalt district of Ontario, and backed its development into a very profitable silver mine. Mr. Denison's next important venture was the promotion of the Dome mine, which was the first of the mines in the Porcupine district to be a success. His last mining venture was the development of the famous Teck-Hughes mine from the then uncertain Kirkland Lake district. He was 64 years of age.

NEWS OF THE INDUSTRY

Bunker Hill Cuts New Ore on Kellogg Tunnel

Crosscutting on the No. 9, or Kellogg tunnel, level of the Bunker Hill & Sullivan mine, near Kellogg, Idaho, has struck the new orebody recently opened in the Sullivan section of the mine. This is 700 ft. below the original discovery on the No. 6 level, where the orebody was 15 ft. wide and showed ore of good milling grade, carrying silver and lead. On the Kellogg level, the ore is said to be of the same width and grade. Drifting is now proceeding at that depth.

The company expects to strike the new oreshoot soon on the No. 17 level, 1,600 ft. below the Kellogg tunnel. Other crosscuts are being run in the intervening area. Discovery of this new orebody has added considerably to the resources of the mine, which has been an important producer for 40 years. Despite low metal prices, operations are being continued profitably at the normal rate.

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Vandenberg Urges Copper Tariff

Arthur H. Vandenberg, United States Senator from Michigan, has come out strongly in favor of a tariff on copper. Michigan Republicans, in their recent state convention, went on record as favoring such a tariff. "Our domestic producers of copper," said Senator Vandenberg, "cannot agree on a program of curtailment of production, because, if they curtail, foreign copper producers rush in and take up the slack. The copper industry of the upper peninsula of Michigan should and must be protected by a tariff wall."

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Suspend Work at Park Konold

International Smelting, Anaconda subsidiary in Utah, has suspended all development work at the Park Konold property, in East Park City, Utah. The work was being done by contract and consisted largely of sinking a shaft to prospect the sedimentary formation. At the time work was suspended, shaft sinking had reached a depth of about 1,000 ft. Suspension will not necessarily mean the discharge of the men employed on the project, as they are employed by the contractors. Whether the suspension at Park Konold is permanent or just the result of the present depressed metal market is not known.

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Mineral Veins Ships From Alta

Mineral Veins Coalition Mines at Alta, Utah, is shipping a small amount of ore from three of its properties. An iron fluxing ore, carrying a good gold content, is being mined in the hanging wall of the old Flagstaff deposit. In the Columbus-Rexall, above the Rexall level, a high-grade silver-lead ore is being mined. In the Wasatch Mines, 5,000 ft. from the portal of the drain tunnel, ore is being mined in the old Columbus Con. territory.

American and Mexican Engineers Join to Make El Paso Meeting a Success

J. B. HUTTL
Assistant Editor

At El Paso, Texas, Oct. 13, 14, and 15, the Western Division of the American Mining Congress and the A.I.M.E. met in joint convention, with headquarters at the Hotel Paso del Norte. Co-operating with these two organizations were the West Texas Geological Society, American Association of Engineers, Arizona Chapter, American Mining Congress, El Paso Chamber of Commerce, and the Centro Nacional de Ingenieros, of Mexico City, adding diversity and international character because of the opportunity to hear something of our neighboring republic and meet her engineers. Vocationally, executives, engineers, metallurgists, geologists, professors, oil men, operators and financiers were present. Brent N. Rickard and associates spared no efforts to make everyone feel at home, and the arrangement of the entire meeting was exemplary. The social affairs, such as daily luncheons, barbecue, excursions, and banquet, offered their usual opportunities for making and renewing acquaintanceship, to say nothing of the entertainments arranged for the ladies. The papers presented were practical and interesting and contained valuable and diversified data for all those engaged in the mining profession. In registration, in quality, and in actual attendance at the sessions, the convention was a noted success. A total of about 450 delegates attended.

The entire Monday program, including morning and afternoon sessions, was under the auspices of the American Mining Congress. Brent N. Rickard called the meeting to order and presided at the morning session. Hearty and spiced with refreshing humor were the addresses of welcome by R. E. Thomason, Mayor of El Paso, and Edgar W. Kayser, president of the El Paso Chamber of Commerce. Following, a "Bienvenido" was delivered by Don J. Quevado, Mayor of Juarez. Sr. Ing. Gustavo P. Serrano presented greetings in behalf of the Mexican government, and also stated that his countrymen were very eager and interested to hear all available information and possible remedies regarding the present silver situation, which is of great importance to the welfare of his country. Among many telegrams received were those of Herbert Hoover, President of the United States; Governor Phillips of Arizona; Governor Ortiz of Chihuahua; Governor Moody of Texas; and Governor Dillon of New Mexico. In response to the addresses, J. F. Callbreath presented thanks in behalf of his society and concluded with a brief and interesting résumé of the history and various phases of the work of the American Mining Congress, in particular stressing the success achieved by the taxation department. The floor was then given over to the reading of papers, of which silver and labor problems were the keynotes. Frank M. Smith read his own paper, entitled, "Silver—What About Its Future?" an excellent and interesting treatise of the present situation, several high lights of which are quoted in the following:

"Experts agree that the decline in our export trade with China has been coincident with the decline in the price of silver.

"The decreased purchasing power of the Chinese people, due to this fall in silver prices, is one of the principal causes of our diminished exports.

"All are agreed that the first step in the pacification of China, not by military intervention, but by peaceful and helpful means on the part of the principal treaty powers, would enable the Nationalist government to either defeat or to make attractive overtures to the war lords.

"If the internal warfare can be brought to an end, the great mass of the people, now compelled to fight for a living, could return to their homes and engage in gainful occupations.

"The plan that meets with most favor is for the United States, together with other treaty powers having commercial relations with China, to make a joint loan to the Nationalist government. It is proposed that this loan should be in silver, say 500,000,000 oz.

"Silver now stored in Shanghai would begin to flow back into the interior. With the people engaged in useful occupations there would soon be created a demand for more silver, which would furnish an almost unlimited market for the silver-producing countries."

As to the future of silver, Smith said that one could only guess, because "nobody knows. Legislation by the United States alone, favorable to silver, appears to be hopeless at this time. Increase in price can come about only by increased demand and consumption."

W. V. DeCamp, in his paper, "Management In Its Responsibility to Industry," advocates that means be found to insure constant employment for workers, and the balancing of production and demand. After the noon adjournment, a luncheon was tendered to the Board of Governors, Western Division, American Mining Congress.

The afternoon session was devoted entirely to operating problems in Arizona, with T. H. O'Brien and E. P. Mathewson presiding. Brief abstracts of the following papers were read: "Mineral Resources of the Southwest," by J. Kruttschnitt, Jr.; "Development and Mining at Inspiration Consolidated Copper Company Mine, Inspiration, Arizona," by A. C. Stoddard; "Résumé of the History and Operations of the Copper Queen Branch, Phelps Dodge Corporation," by J. B. Pullen. The paper, "Long Hole Prospect Drilling at the Ray Mines of the Nevada Consolidated Copper Company," by M. Brown, Jr., was

not read, because of the absence of the author. J. D. Sullivan gave a brief description of leaching practice in Japan, after which the meeting was adjourned.

In the evening the chief drawing card was the barbecue held at the Juarez Beer Gardens, Juarez, Mexico, embracing many attractions such as ball games, boxing, Pelea de Gallos, and dancing. To go into further detail would be giving family secrets away—so let it suffice that everyone had a wonderful time.

Tuesday was devoted to the affairs of the A.I.M.E. Brent N. Rickard opened the morning session, formally introducing W. H. Bassett, president of the Institute. After the preliminary addresses the meeting was turned over to H. L. Carr, chairman. Secretary H. Foster Bain delivered a brief introduction, after which oral abstracts of the following papers, dealing mainly with mining and milling methods, were presented by the various authors: "Milling Practices at the San Francisco Mines of Mexico, Ltd., San Francisco del Oro, Chihuahua, Mexico," by Glen L. Allen, because of the absence of the author was read by Prof. J. T. Graham; "Concentration of Oxidized Lead Ores at San Diego Mill of the Santa Barbara Unit, Cia. Minera Asarco, Santa Barbara, Chih., Mexico," by A. J. Monks and N. L. Weiss; "Top-Slicing With Filling of Slices, as Used at the Charcas Unit of the Cia. Minera Asarco, Charcas, San Luis Potosi, Mexico," by Howard Willey; "Milling Methods and Costs at the Presidio Mine of The American Metal Company of Texas," by Van Dyne Howbert and Fred E. Gray; "Critical Factors Controlling Ore Deposition in Limestones of Northern Mexico," by John G. Barry. The last-named paper, dealing with geological facts, naturally drew a lively discussion, in which M. W. Hayward, Thomas P. Glendenning, and J. J. Beeson took part.

At noon a special luncheon was given at the Hotel Hussman in honor of the delegates. The papers read during the afternoon session, at which E. P. Mathewson presided, dealt chiefly with pyrometallurgy. Because of the valuable data contained, and the opportunity to hear of recent developments in the use of natural gas at the El Paso smelter, an unusually large crowd attended. Col. H. H. Stout's paper, "History and Development of Pyrometallurgy at the Copper Queen Smelter," could not be presented, because of its non-arrival. C. W. Clark read a brief résumé of Frank R. Corwin's paper, "The El Paso Refinery of the Nichols Copper Company," which was followed by a discussion in which Frank Ayers, J. D. Sullivan, H. A. Clark, J. O. Ambler, and E. R. Marble took part, complimenting on the construction of the new refinery in general and stating that the few difficulties encountered when placed in operation had been successfully ironed out. David Cole stated he regretted that because of its incompletion his proposed paper, "Recent Developments in Primary Crushing," could not be presented at this meeting, but gave an interesting historical presentation of crushing practices developed in recent years. Van Dyne Howbert delivered a brief abstract of the paper, "Mining Methods and Costs at the Presidio Mine of the American Metal Company of Texas," by himself and Richard Bosustow. With the pending installation of natural gas at various smelters in the Southwest, E. R. Marble's paper, "Natural Gas Firing at the El Paso Smelting Works of the American Smelting & Refining Company," was of great interest to the smelter men. Mr. Marble presented instructive data on the design and performance of burners, B.t.u. efficiency, the advisability and advantages of using two-stage burners on the reverberatory furnaces, gas pressures, temperatures, and the advantages of natural gas in smelter work in general. The ensuing discussion was exceedingly interesting. President Bassett stated that during the last few years considerable experimenting has been conducted to replace the wood poling method with natural gas at copper refineries, but to date with negative results. A partial substitution of coke with gas on the lead blast furnaces also resulted in negative effects, according to Marble. J. O. Ambler, H. A. Clark, Brent N. Rickard, and F. X. Mooney also contributed to the discussion. Following the adjournment an interesting film entitled, "The Story of Anaconda From Mine to Consumer," was shown for the benefit of the delegates.

Another rare and interesting feature of the day was the opportunity to see an "Antiguo Adobe" lead furnace in operation at the El Paso Smelting Works. The furnace was operated by a Mexican crew, lending reality to the picture. The courtesy of the smelter officials made possible the gathering of metallurgical data and information concerning the design of the furnace, and I shall endeavor to present the details at an early date.

In the evening the directors of the A.I.M.E. were entertained at dinner, which was followed by an open meeting of Institute members.

The morning session on Wednesday was given over to the affairs of the West Texas Geological Society, the American Association of Engineers and the Centro Nacional de Ingenieros de Mexico. Brent N. Rickard welcomed the societies in behalf of the American Mining Congress and the A.I.M.E., after which three excellent papers, covering geological features, natural gas, and sulphur deposits of west Texas, were read, with R. E. Rettger as chairman of the meeting. Abstracts of Dr. H. P. Bybee's paper, entitled "General Geologic Features of West Texas and New Mexico, With Special Reference to Petroleum Accumulations," were followed with great interest by the numerous geologists and others present. The maps and charts presented with the paper were well executed and appreciated by the audience. Dr. Bybee, in concluding, discussed briefly a paper by C. P. Butcher on gas resources of New Mexico. Interesting comment followed, in which C. L. Baker took part. E. L. Porch, Jr., ably discussed the sulphur deposits of west Texas and showed several lantern slides, supplemented by oral explanations. He stated that these deposits cannot compete commercially with the Gulf sulphur deposits, but may become important producers when the need arises.

For the American Association of Engineers, G. E. Gamewell presided. Dr. G. M. Butler presented an excellent paper explaining the aims and objects of the association. Sr. Ing. Gustavo P. Serrano, who is Commissioner for Mexico of the United States and Mexico Boundary Survey, conducted the affairs of the Centro Nacional de Ingenieros de Mexico. After discussing the need of a closer co-operation between the American and Mexican engineers, and extending a hearty invitation that the next annual convention be held at Mexico City, which in his opinion would further the relationship between the two countries, Sr. Serrano read brief high lights of Santiago Gonzalez' paper entitled, "History of Mining of the Past and Future in Mexico." Following, Sr. Javier Horcasitas, of the Department of Industry and Commerce of Mexico, read brief abstracts of "Mining Incorporations in Mexico," by Lic. Alberto Terrónes Benitez, and also discussed the new mining law, recently put into effect, with the audience.

After the close of the session a luncheon was given in honor of the members of the West Texas Geological Society at the Hotel Paso del Norte.

Operating problems in New Mexico were the keynote of the afternoon session, which was again taken over by the American Mining Congress. The three papers presented by their respective authors—namely, "Methods of Determining Metallurgical and Efficiency Results at the Selective Flotation Mill of the Black Hawk Consolidated Mines Company," by Ira L. Wright; "Mining Practice at the Pecos Mine of the American Metal Company of New Mexico," by J. T. Matson and C. Hoag; and "A Sandstone Copper Deposit," by I. J. Stauber—contained valuable mining and milling data. The ensuing discussion was lively and instructive, with W. H. Eardley, of Salt Lake; M. W. Hayward, S. G. Lasky, J. G. Barry, and R. H. Hale contributing. H. E. Wells, president of the New Mexico School of Mines, presided. At the conclusion of the meeting F. M. Smith read the report of the committee on resolutions to be presented to the directors of American Mining Congress, for increased appropriations for prevention of forest fires, revisal of the Norbeck Bill, the silver situation, and increased appropriations for printing of technical literature. This closed the technical part of the convention.

In the evening the annual banquet and ball was held in the banquet hall, Hotel Paso del Norte, with Brent N. Rickard presiding and Cleon T. Knapp as toastmaster. The variety program presented and the speeches, both serious and humorous, by President Bassett, Dr. Henry Mace Payne, Gustavo P. Serrano, and J. Walker Morrow, were excellent. Good-fellowship, humor, and enjoyment prevailed throughout the entire evening. In conclusion, may the fact be emphasized again that the efforts on the part of Brent N. Rickard, N. H. Fields, and their co-workers, not forgetting the fine work performed by the Ladies' Entertainment Committee, and the entire community of El Paso, were not in vain, and remembrances of this successful convention will always linger with those who attended.

On Thursday and Friday, those of the members who desired to do so had the opportunity of making trips to various mining and industrial centers. In El Paso itself, visits were made to the A. S. & R. smelter and the Nichols refinery, as well as the plants of several oil companies and the local power station. Special excursions were made to the Chino mine and mill at Santa Rita and Hurley, N. M., as well as to the Carlsbad Caverns, in New Mexico, and Chihuahua City, Mexico.

Joplin was selected as the 1931 meeting place of the Western division of the American Mining Congress. C. F. Dike, of Joplin, manager of the Interstate Zinc and Lead Corporation, was elected president of the division and M. D. Harbaugh, of Miami, secretary of the Tri-State Zinc and Lead Ore Producers' Association, secretary, for the coming year. Invitation probably will be extended the Joplin-Miami section and the St. Louis section of the A.I.M.E. and some of the petroleum institutes of Oklahoma and Texas to meet in conjunction with the western division at Joplin.

Metal Prices Force Closing of Several Canadian and U. S. Producers

Several base-metal properties operating in the United States and Canada, each handling more than 300 tons of ore daily, have announced suspension of production since the beginning of the month. These properties include Base Metals, operating a lead-zinc mine at Field, B. C.; Amulet Mines, operating a copper-zinc property in the Rouyn district of Quebec; St. Joseph Lead's Block P unit, at Hughesville, Mont.; Missouri-Kansas Zinc, which operates several mills in the Tri-State; Sunnyside Mining, largest producer in the San Juan basin of Colorado; and Shattuck Denn, independent copper mine in the Bisbee district, Arizona. At least two of these companies were making operating profits even with metal prices at present low levels, but the directors decided that continued depletion of ore reserves without adequate return was not warranted.

Shattuck Denn Mining had been producing daily about 400 tons of copper ore, running from 5 to 6 per cent copper, from its Denn mine, which was equipped and put into production on a large scale early in 1929. The Shattuck mine has been yielding only small tonnages from development work. Total copper production was about 1,500,000 lb. monthly for a time, although recently it has been about 1,200,000 lb. Suspension of production, which will go into full effect on Oct. 31, will not affect development work. The company has found in the past that its shaft facilities are not sufficient to permit a full quota of development work while stoping operations are being carried on, and therefore the suspension of production will permit exploration hitherto not feasible. Cost of producing copper from the Denn mine was only 8.9c. per pound in the last six months of 1929, indicating that even under present conditions the company could have made expenses had it so desired.

The Block P mine, near Hughesville, Mont., which St. Joseph Lead has been operating for several years, was the largest producer of lead and one of the largest producers of zinc in Montana in 1929. Closing of the 400-ton concentrator will affect about 250 men employed there. As soon as the metal markets improve, operation will be resumed. Development has been carried to a depth of 1,200 ft.

On Oct. 1, the Sunnyside mine, subsidiary of U. S. Smelting, Refining & Mining, at Eureka, Colo., shut down its mill for an indefinite period, or until such time as metal prices, particularly lead and zinc, go up to the point where profitable operations can be maintained. The mine is understood to have been operating at a loss for several months, as the company had hoped to avoid the large loss caused by shutting down and starting up again. Sunnyside has been operating its mill to full capacity almost continuously for the last ten years, and during that period it has been the largest producer of ore in Colorado, with the exception of the Climax Molybdenum, which, for the last year or two, has been operating at a little more than 1,000 tons daily. Sunnyside has employed about 400 men, and when the shutdown occurred, nearly all of them left the camp at the same time. The management has announced that it will continue underground development, especially the sinking of the shaft on the Washington oreshoot, now bottomed at 1,900 ft. below the outcrop and several hundred feet below the main tunnel. Other ore deposits will be explored.

American Smelting & Refining will soon discontinue the operation of its smelter at Durango, which has served the San Juan district for so many years. This has been made necessary by the shutdown of the Sunnyside mill. Officials of the company have not yet decided which smelter will be best adapted to handle the remaining production from the San Juan—the one at El Paso, Tex., or at Leadville, Colo. G. Y. Walker, of the New York office, is expected in Colorado in the near future and will confer with local officials. A decision will be announced later. Shenandoah-Dives, the largest remaining shipper from the San Juan, is producing largely copper concentrate, which is more suitable for the El Paso smelter, but treatment at Leadville may be found advisable.

The drop in the price of Tri-State zinc concentrate to a $27 a ton basis on Oct. 18 caused the closing of all the mills of Missouri-Kansas. The company produces about 350 tons of zinc concentrate weekly from mines in the area near Waco. No other suspensions had been announced up to Oct. 20 in the district, but several more are expected.

Base Metals put its new 350-ton mill into operation last December. Ore is comparatively high grade and operating costs, both for mining and milling, have been kept at about $3 a ton, so that even with the present low prices a profit has been realized. Reserves are estimated at about 500,000 tons, averaging 30 per cent combined lead and zinc. The directors have decided to conserve them for a period when profits will be greater. Lead concentrate had been shipped to the Selby smelter of A. S. & R., near San Francisco.

Amulet Mines has been operating its 350-ton concentrator near Rouyn only since April. Production of copper concentrate has been smelted at the Noranda smelter, and zinc concentrate has been shipped to Europe. A small margin of profit was maintained while copper sold at 12c. a pound, but probably the most recent drop in the price of the metal has wiped this margin out. Reserves of ore have been estimated at 527,000 tons averaging 3 per cent copper, 11 per cent zinc, and 2.5 oz. of silver per ton. Net profit on the first two and a half months of operation was $20,043.

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Extend A. S. & R. Option on Globe

American Smelting & Refining has been granted an additional period in which to do development work under option on the Globe Mining property in Mary Ellen Gulch, American Fork Canyon, Utah. Supplies are now being shipped to the camp to permit continuation work on the Globe and the adjoining Yankee Mines property during the winter. A. S. & R. has driven 1,362 ft. of new workings since taking over the properties, as well as installing additional equipment. At the Frisco Lulu property, in Beaver County, which it is also exploring, work has been stopped on the 400 level but is being continued on the 200. Having lost the first diamond-drill hole in the Silver Creek area, near Park City, A. S. & R. is now putting a second hole down. At the East Utah property work has been stopped temporarily.

Ontario Gold Discovery Starts New Rush

Mining and prospecting circles of northern Ontario were set agog last week end by reports of a gold discovery in Bannockburn Township, 60 miles northwest of Elk Lake, in the Matachewan mining district, and almost due west of Kirkland Lake. The discovery was made by Bert Ashley, of Haileybury, who was prospecting for a local syndicate. Visible gold and tellurides are reported to have been uncovered in a quartz vein ranging from 4 to 8 ft. in width. The vein has been uncovered for a distance of 400 ft. and is reported to show high grade at various points in this distance. It strikes north and south and dips west into low ground. Heavy pannings of coarse gold have been obtained from various parts of the exposed surface and three samples are said to have yielded values of $136, $36, and $6 per ton.

The original discovery group consists of eighteen claims and will be developed by Mining Corporation of Canada. Bert Ashley and William Garveywill, the stakers, each holds a 10 per cent interest. Owing to its location in the Ontario Forest Reserve, development of the Matachewan district has been retarded in the past by restrictions on performance of assessment work. J. M. Coghill has announced that regulations requiring a special permit for assessment work have been lifted from five townships surrounding the discovery—Argyle, Bannockburn, Baden, Montrose, and Hincks—and claims staked therein would be subject only to the usual working conditions. Prospectors and mining scouts are invading the area. More than 350 claims have been staked in these townships in two weeks. H. C. Rickaby, government geologist, has flown into the area, and is now making a report for the Ontario Department of Mines.

The Bannockburn find has already received considerable attention in the press. Mining engineers familiar with the country, however, state that a good deal of time must elapse before its importance can be determined. Overburden is heavy in the district, and transportation facilities are limited largely to the West branch of the Montreal River. The Matachewan district has been known as gold-bearing for many years, although Bannockburn Township itself has not received much attention, because more than half of its area is covered by Cobalt conglomerate, which is of later origin than most of the Ontario gold mineralization.

When the Sinclair exploration line was put through the Matachewan area, in 1867, reports were circulated that the exploring party had found gold. These reports were responsible for most of the exploration work that has since been done in the district. Matachewan Gold Mines worked the Otisse property, in Powell Township, east of Bannockurn, for several years about 1916-1920, but the deposits proved to be small and erratic.

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New Tunnel at Cherry Creek

Standard Mining, operating at Cherry Creek, north of Ely, Nev., has started a drainage and haulage tunnel to cut the Star vein about 2,200 ft. from the portal. The tunnel, now in about 125 ft., is still in the wash. The Standard's 100-ton mill was shut down for several weeks, undergoing some changes designed to effect a higher recovery. It is now handling about 75 tons of gold ore daily to test efficiency.

Grade Improving at Depth in Venezuela Gold Property

Since the beginning of 1930, development work totaling 1,406 ft. has been done in the property of New Goldfields of Venezuela, State of Bolivar, Venezuela, and 1,024 ft. has been in ore averaging 12.5 dwt. in gold per ton, according to J. A. Agnew, chairman of the company. Ore reserves in the properties of the company, which now include ground held formerly by Bolivar Venezuela Gold, were estimated at 442,827 tons of an average grade of 9.7 dwt. at the beginning of the year. The additional tonnage blocked out by the recent development work has not been calculated, but the improvement in grade is considered encouraging, as the work was done on the lower levels.

Operation of the new mill, started on May 17, has been satisfactory. Recovery has gradually improved and is now about 96 per cent of the gold content. The plant has been handling only about 150 tons daily, although its rated capacity is 350 tons, because only one of the two Hardinge ball mills has been put in operation. Eventually the company intends increasing capacity to 1,000 tons daily.

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Peñoles Closes Achotla Unit, in Guerrero, Mexico

Permission having been received from the Mexican government, operations at the Achotla unit of Compañia Minera de Peñoles, American Metal subsidiary, were completely suspended on Oct. 15. The drop in the price of silver made continuation of operations at this silver-gold mine, which is in Guerrero, unprofitable and the company applied for permission to close down some time ago. For about the last month and a half, the mill has been handling only about 100 tons of ore daily, although its capacity is 300 tons. Reopening of the mine will depend entirely on improvement in the price of silver.

Peñoles has not yet made a decision as to the construction of a concentrator at its Avalos properties, in Zacatecas. Even if the company does decide to put up a plant to treat the lead-zinc ore available, actual construction will probably be deferred until metal prices improve.

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Saenz Appointment and New Law Cheer Mexican Miners

Appointment of Aaron Saenz to head the Department of Industry, Commerce, and Labor at almost the same time as the new mining law was put into effect has created an excellent impression among Mexican mining men, indicating, as it does, the desire on the part of the present government to assist the industry. The new law, which supplants the one passed by May 3, 1926, is expected to stimulate prospecting activity. As Secretary of Industry, Commerce, and Labor, Sr. Saenz will be in direct charge of all matters pertaining to mining. He has had long experience in other cabinets and is expected to handle the various problems of the industry from a practical viewpoint.

Metal taxes for September, based on production, were 791,466 pesos, a slight increase over the figures for August. The closing of several important mines within the last few weeks and the reduction of tonnages handled at other properties are expected to lessen considerably the tax yield in the remaining months.

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New Ore at La Noria Mine Cut on Deeper Level

Downward continuation of the orebody developed by Inversiones del Oro, subsidiary of El Oro Mining & Railway, at the La Noria mine, near Sombrerete, Zacatecas, Mexico, has been cut on the 266-m. level, according to G. M. Wasteneys, general manager of the company. This orebody lies east of the shaft and has been opened on the 236-m. level for a distance of more than 90 m. It has a width of about 9 m. and assays about 1,100 grams of silver per ton. To date on the 266-m. level it has been opened for 20 m. and assays 1,500 grams of silver.

This orebody is believed to be the downward continuation of the San Pedro orebody. Development east of the shaft on the 166-m. level has been disappointing and on the 206-m. level only occasional shoots of ore were encountered. The fact that this zone of secondary enrichment has been encountered underlying an extensive poor leached zone encourages the management to believe that similar high-grade orebodies may be opened beneath the leached masses of siliceous vein matter that underlie some of the other large orebodies that have been worked at this property.

On June 30, ore reserves at the property were estimated at 205,150 metric tons of an average grade of 605 grams of silver per ton, which is 95,000 tons lower than the estimate at June 30, 1929. Elimination of considerable low-grade material because of the drop in the price of silver is responsible for the lower reserves. Nevertheless, Mr. Wasteneys believes ore prospects of the property are considerably better than they were a year ago.

At present the mill is handling about 14,000 metric tons of ore monthly. The concentration ratio is about 40:1. By the use of "Aerofloat" as a reagent, recovery has recently been improved, and it is now about 85 per cent, compared with 81 per cent in the last fiscal year. Other additions have been made to milling equipment to improve the efficiency.

Because of the drop in the price of silver, a reduction of 14 per cent in wages and salaries has been put into effect. Furthermore, the Mexican government has given the company permission to dismiss up to 300 men on payment of ten days' wages and railroad fare. The company has not yet found it necessary to put this permission to effect.

■

Report Nickel in Brazil

Press reports state that a promising nickel deposit has been located in southern Minas Geraes, Brazil, near the village of Livramento. The predominating mineral is reported to be garnierite (hydrous nickel-magnesium silicate) and its varieties, and drilling is said to indicate the presence of ore with a nickel content of almost 7 per cent. The tests so far have been mainly superficial. Outcrops of the same mineral at other points in the vicinity have been reported.

Expect Increase in Output of Tonopah Mining Leases

On Oct. 11 Tonopah Mining shipped from its Desert mill, near Tonopah, Nev., eight bars of bullion valued at $28,000, as the cleanup for August and September. Nearly all the ore producing this bullion came from leasers on the old Mizpah workings. Beginning with the week of Oct. 20 from five to ten carloads of ore are expected to go to the Desert mill each week.

E. M. Booth and Eugene Moffet, one of the 31 sets of leasers on the Tonopah Mining property, opened rich ore almost at the first hit of the pick. They operate a block on the surface of the Mizpah, not far from where Jim Butler made his first discovery. Tom Kendall, another old-timer, has the adjoining lease block. He is in ore, but it is not so rich as the Moffatt-Booth find. Both of these leasers are sacking ore for shipment. Three other leased blocks are reported in shipping ore and five in milling ore. In all, about 100 men are at work.

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Federal Buys Granby Area in Tri-State District

A tract of 7,500 acres of mining land at Granby, Mo., 26 miles southeast of Joplin, which in 1916 was sold to American Zinc, Lead & Smelting for $7,500,000 by Granby Mining & Smelting, has been sold to Federal Mining & Smelting for about $300,000. The Federal company has had a lease on the property for several years and up until a few years ago operated a large concentrator thereon. It has been paying advanced royalty during the last few years.

■

Decide Tonopah Ex. Suit

H. J. Pinney and Will Fredrichsen, stockholders in Tonopah Extension, have suffered defeat in the U. S. Supreme Court in their suit to have the sale of the property to T. F. Cole set aside. Although they have a 25-day allowance to file petition for rehearing, they are not likely to do so, since their suit has been defeated both in the district and circuit courts, as well as the Supreme Court. Mr. Cole bought the Tonopah Extension property, consisting of mine and mill in the Tonopah silver-gold district of Nevada, after the company had been put into receivership.

■

Install Furnace at Lovelock Mine

Antelope Springs Mercury, operating near Lovelock, Pershing County, Nev., is installing a 30-ton Weller rotary furnace. Other machinery at the property is being covered with galvanized-iron buildings. C. N. Schuette is in charge and L. C. Newton, iron manufacturer, of Los Angeles, is president of the company.

■

Build Mill at Imlay, Nev.

Tehama Mines Syndicate, at Imlay, Nev., is now installing a 20-ton Rib-Cone milling plant, together with Overstrom Universal tables and Straub crushers. This plant is for the purpose of treating gold-copper ores.

The new 1,300-ton plant of Wiluna Gold, in Western Australia, as it appears under construction. Left to right are the precipitation, filter, roasting and grinding, and crushing sections.

Final Decision Rendered in Ely Mining Dispute

On Oct. 13, Judge Frank H. Norcross, of the federal court at Carson City, Nev., handed down a final decision in the case of Nevada Consolidated vs. Consolidated Coppermines, which involved a dispute over mining of adjoining claims at Ely, Nev., where the two companies operate porphyry copper properties. A preliminary decision on some of the more important aspects of the case was rendered about three months ago. The proceedings were resumed on Oct. 6, subordinate phases of the issue being heard. Decision on several counterclaims of Consolidated Coppermines has been reserved, but in the main Judge Norcross has upheld the interpretation of the contract for working the Liberty and Champion claims that was made by Nevada Consolidated. Coppermines is enjoined from interfering with the Liberty pit operations in the Liberty and Champion claims in any way until the pit has been carried to the lowest level to which Nevada elects to mine it.

■

Tombstone Recalls Old Days

Many colorful incidents of early Arizona mining days occurred again as Tombstone, Ariz., held its annual "Heldorado," Oct. 16 to 19. Aiding in the presentation of these events, which were re-enacted on the grounds of the Tombstone Union High School, were a pair of ancient stage coaches that saw service in the early 'eighties, a pack train of twenty mules from Fort Huachuca, equipped as they would have been 50 years ago, and a delegation of Apache scouts. Among the events were the famous gun battle between Virgil, Morgan, and Wyatt Earp on one side against Ike and Billy Clanton and Frank and Tom McLowery on the other, the lynching of an outlaw and a stage hold-up. Pioneers of the district who lived in Cochise County previous to 1900 were entertained at a luncheon by the town of Tombstone.

■

Reopen Wyoming Iron Mines

The iron-ore mines of Colorado Fuel & Iron, at Sunrise, Wyo., which have been shut down since July, are now being reopened. The company has recently obtained an order from the Atchison, Topeka & Santa Fe railroad for 47,500 tons of rails. As a result, the mill has been started again and additional open-hearth furnaces have been fired.

■

Resume Work at Bannack Mine

I. D. Mining, which recently took over operation of the properties of New York Montana Mines, near Bannack, Beaverhead County, Mont., has made arrangements with the Montana Power Company to run an 18-mile power line to the mines from a point near Dillon. The property is equipped with modern mine machinery and a cyanide plant of 150 tons' daily capacity.

■

Sink Shaft at White Hills Mine

Shaft sinking is being resumed at the silver-gold property of White Hills Silver Mines, north of the Hoover Dam site, in southeastern Nevada. The main three-compartment shaft is now at a depth of 384 ft. Water and financial troubles have hampered development of the property, which is said to have produced 8,000,000 oz. of silver and some gold since 1904.

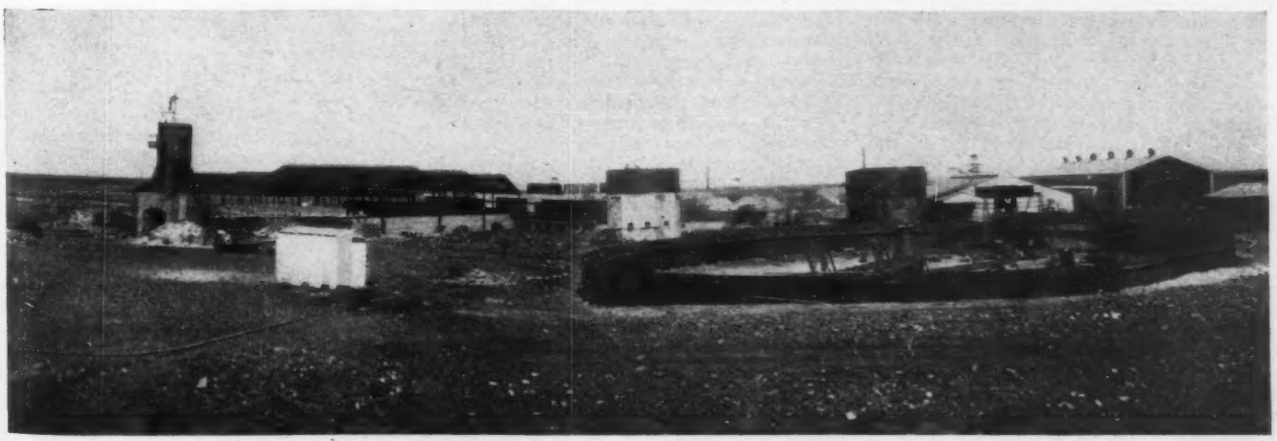
Howey Report Shows Property May Be Low-Grade Mine

Chances for the success of Howey Gold, pioneer large-scale gold producer in northwestern Ontario, apparently rest on development of the property into a large-tonnage, low-grade enterprise, the annual report of the company indicates. Grade of the ore treated since operations started has been only $4.43, including a small tonnage of dump material. Costs have been gradually reduced to $3.25 per ton before deductions for depreciation and taxes.

In mining ore, the company has been using greater widths than those indicated by development, and the subsequent dilution has reduced the grade below the $6.50 previously estimated. Above the 1,000, the manager, H. G. Young, states that 1,125,000 tons of positive ore and 375,000 tons of probable ore are indicated, but no grade is given. At present, 500 tons of ore is being handled daily, but expenditure of $75,000 would bring mill capacity up to 1,000 tons. Power consumption is only 1,300 hp., although under its agreement the company is paying for 2,000 hp.

Huronian Mining & Finance prepared an independent report on the property, an abstract of which is published in the company's report. J. Leslie Mennell is the engineer signing this independent statement. He states that by sorting the mine ore at the surface plant the grade might be improved to better than $5 a ton. Should this be accomplished, it also may be found possible to adopt cheaper mining methods, by exploiting all or most of the dike, relying for grade upon surface sorting. The dike in which the ore occurs averages about 50 ft. wide for the length developed and its minimum grade is estimated as $2.75 a ton. Chances for extending the ore zone below the 1,000 level are considered excellent.

Another view of the Wiluna plant, with the main shaft headframe under construction at the left and the traction thickener in the right foreground



In the ball-mill section of the concentrator at Roan Antelope, 9x8-ft. Marcy units are being used. As the picture at the left shows, several of these are already set. On the right is the coal-pulverizing plant.

Bassett, Bradley, and Probert Speak at S. F. Meeting

Members of the San Francisco section of the A.I.M.E. turned out in full force on Oct. 2, 1930, to greet W. H. Bassett, president, who is on the annual presidential tour of the Institute's sections in various parts of the country. C. N. Schuette, chairman for the evening, introduced the speakers. F. W. Bradley, former president of the Institute, discussed economic conditions and dissected the price position of lead in relation to economic history, major depressions, and war periods. He pointed out the difficulties in predicting the average price of lead and discussed the relative values of the metals at different periods as well as per capita consumption for various countries. Metal producers, he said, have found out that they are not strong enough to control the price of copper. Efforts at price stabilization have failed and will always fail unless undertaken with the world's consent.

Upon the interesting subject of gold and silver, Mr. Bradley stated that gold is not a perfect standard because it does not have a fixed value. "Silver," he said, "does not possess the lure for search that gold does. Even if silver were given monetary value by some rightly chosen ratio to gold it would not be mined for itself alone, but would be produced along with other metals with which it occurs as a byproduct."

Changing points of view were commented upon as follows: "Thought now is being given by some advocates of the gold standard basis to the probable need for a broader metallic moneyed basis for future world requirements. Active consideration of a matter of this kind can be best undertaken by an international committee such as the League of Nations has appointed. The business of the principal nations of the world is, undoubtedly, suffering now from the lessening purchasing power of the silver-using countries, which contain more than one-half of the population of the world. This country is now learning to its sorrow that it must trade with other nations of the world in order to prosper and other nations cannot buy from us unless they are prospering. So the investigation as to some restoration of the monetary use of silver should be seriously urged and expedited in order that over one-half of the world may be able to prosper and thus add to our prosperity."

Dean Frank H. Probert illuminated ideas for the alleviation of depressions and their prevention by strongly advocating research and advertising and the study of markets. Commenting upon the inflated price of copper, he said: "Had the market price of the metal been set at 15c. per pound, today's debacle would not have occurred and certainly it would not have been so serious." The price of progress is research, he declared. It alone assures the payment of dividends.

Mr. Bassett, the speaker of the evening, characterized this as the age of metals. After fulfilling the needs for water, fire, and air, present-day achievements, he said, make metal our greatest necessity. Mining, rather than agriculture, is our basic industry, for, if there were no mines, agriculture could not continue to feed our population. He commented upon the great variety of metals other than steel now in everyday use and dilated upon the good properties of copper alloys and the great progress in the discovery and utilization of new alloys, instancing the corrosion-resisting group as one of the modern developments. Copper-silicon alloys were described as well as beryllium and its alloys with copper.

Mr. Bassett stated that the increasing demand for metals is not steady but approximates a series of waves, each succeeding one of which reaches higher up upon the shore. Between the waves are depressions. The old rule that the copper business doubles every ten years still holds, he believes. The 1930 recession was brought about by lessened consumption resulting from the general slowing up of all industries rather than from any special cause.

In concluding his informative address, Mr. Bassett stated that no one knows when the present business depression will end, but that some believe that we have reached the bottom. In his opinion we have not been there long enough to determine whether we have or have not.

■ ■ ■

Records Broken in Contests at Utah Fair Mining Day

All past records for shoveling and drilling were broken during the contests held on Mining Day at the Utah State Fair on Oct. 8. Miners and first-aid teams from all parts of the state were entered in the competitions, sponsored by the Mining Committee of the Chamber of Commerce and the Utah Safety Society. Oscar Viklund, of Eureka Standard, at Tintic, won the shoveling contest, and James Williams and Alfred Nelson, of United States Mining, at Bingham, won the drilling contest.

In the shoveling contest, the entrants were required to load one ton of coal from a concrete floor into a standard mine car, set on a Fairbanks-Morse scale. Elimination contests were held at the several mines to insure representation by the best men of each mine. Mr. Viklund's time was 2 min. 5⅝ sec. First prize was $50 in silver. Second place was won by Roy Pentico, Park City Consolidated, in 2 min. 7⅛ sec. He received $35. "Hump" Richmond, of Tintic Standard, won third prize of $25 in 2 min. 11⅜ sec. Oliver Ames shovels, with an alloy heat-treated blade and No. 4D handles, supplied by Mine & Smelter Supply, were used. Mine cars were furnished by Provo Foundry & Machinery. Paired with Danzil Greenhalgh, also of Eureka Standard, Mr. Viklund took first prize of $75 in the two-man contest. The time was 57 sec.

A 3,400-lb. block of granite, 24x32x42 in., was used in the drilling contest. Contestants supplied their own steel and single jacks, ¾-in. steel being used. In the 10 min. allotted, Williams and Nelson, the winners, drilled 15⅞ in. M. B. Lewis and William Mair, of Park Utah Consolidated, took second by drilling 14¹¹⁄₁₆ in. First prize was $100 and second prize $75.

Utah Copper's Magna mill team won first place in the state-wide safety contest, followed by the Salt Lake City Police Department and the Bingham Canyon team of Utah Copper.

■

Quincy Cuts Wages Again

Quincy Mining has announced a further reduction of 10 per cent in the wages and salaries of its employees, at its properties near Hancock, Mich. The mine will continue to operate five days a week, with emphasis on development work rather than production.

New Laboratory Near Washington Seen as Necessary for Bureau of Mines

A new physical laboratory near Washington, D. C., is regarded as essential to any program that would enable the U. S. Bureau of Mines to meet the pressing demands from the mining and metallurgical industries for its services. Many projects that the Bureau has been called upon to initiate have been deferred because it lacks physical facilities and funds. The Bureau's estimates for the fiscal year commencing July 1, 1931, are now in the hands of the Budget Bureau. In its 1928 platform the Republican party pledged assistance to the mining industry through increased appropriations for research. If the helium program ordered by Congress is excluded, the Bureau's appropriations have shown little if any increase in recent years. Funds available for its regular work total $2,287,490 this year, compared with $2,225,007 last year and $2,283,284 in the fiscal year 1928-29.

The Bureau's research program is the product of a mixture of expediency and opportunism. Funds provided by Congress frequently are earmarked for a specific project, and consequently cannot be used for work that should take precedence. If the needs of industry were considered more carefully by Congress, the Bureau's program would be extended in several directions. The extension of safety work to metal mines and to a larger extent than at present in the cement and quarrying industries is sought. In the competitive struggle of the fuels, the Bureau's work in testing gas, coke, and the byproduct making properties of coal is assuming increasing importance. Although the work to date has been on a small scale, it has demonstrated that wider research in this field promises to contribute much to the development of byproduct fuels.

Development of new and improved geophysical apparatus and continued research in improving mining methods and reducing costs of operation offer a fertile field. Mining engineers throughout the country are co-operating with the Bureau in the preparation of data on methods and costs in individual mines, with summarized reports on the costs of mining various metals according to the methods employed. In response to the pressure of production for wider markets, the Bureau is investigating problems of separation and dressing, searching for new uses for available materials and uses for materials not heretofore used. To initiate this program on a comprehensive scale the Bureau requires a laboratory conveniently located in order that specialists now employed in administrative work at headquarters may also devote some time to laboratory research in their particular fields.

The nine Foster experiment stations of the Bureau, on the campuses of state universities, could be utilized much more effectively if more funds were available to apply at the "cutting edge" of research. There have been repeated requests that the Bureau resume its fundamental research in flotation, gravity concentration, and classification. A reduction in grinding costs can come only with basic research in crushing and grinding directed toward improving the efficiency of machinery. Concentration of low-grade manganese ores is a problem in which the Bureau's expert assistance is desired. Those who are looking into the future have suggested the undertaking of research on the concentration of low-grade iron ores. The preparation and beneficiation of nonmetallics also present a wide field in which the Bureau has been requested to expand its research.

In addition to the technical work that has been suggested for inclusion in the Bureau's program, is the demand for economic studies of the mineral industries. The Bureau is bombarded with requests for information on production, consumption, marketing, and price trends. A considerable amount of data of this character is available for copper, lead, zinc, and gold, but the series is still far from complete. Depression in the silver industry has prompted a request for a new study of the economic relationship of silver to copper, lead, and other metals.

The new uses that rare metal alloys are finding in the electrical, automobile, and aviation industries have inspired requests for information that requires a survey of the occurrence of rare metals, production costs, and their present and potential applications. The disturbance caused by the entry of substitute materials in construction has inspired requests for factual data on the marketing of sand, gravel, cement, and other materials, the trend of demand, and information on new uses that the Bureau cannot supply unless it studies the whole situation.

■

Install Dredge Near Clifton

A dredge capable of handling 1,500 cu.yd. of gold gravel daily has been installed in the San Francisco River bed, south of Clifton, Ariz., by Howard Kenyon Dredging, of Houston, Tex., and operation will be started at once. The machine has a 55-ft. boom and a 1-cu.yd. capacity drag line outfit. The company has acquired title to an area of placer ground running from a point 4 miles south of Clifton to the mouth of the San Francisco River. Howard Kenyon is manager.

■

Scrap Smelter at Benson, Ariz.

The old smelter that has been a landmark at Benson, Ariz., for many years is being torn down and sold for scrap and second-hand material. It was rebuilt 36 years ago at a cost of $250,000 and was operated thereafter for several years. Since that time it has changed hands several times and has been operated intermittently.

■

High-Grade From Cripple Creek

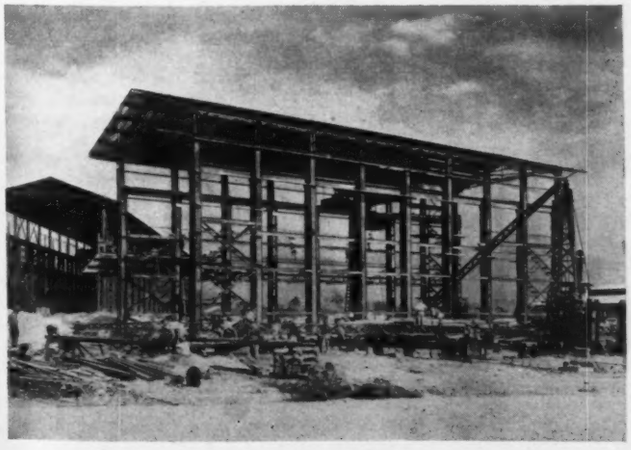
The richest shipment of high-grade gold ore from Cripple Creek, Colo., since 1913 has been made from the Revenue vein of the Golden Cycle mine, belonging to United Gold Mines, on the lease operated by Jerry Skala and Jack Jones. Fine screenings settled at 380 oz. of gold to the ton and coarser screenings at 90 oz. and the oversize on a 1½-in. grizzly, 30 oz. to the ton.

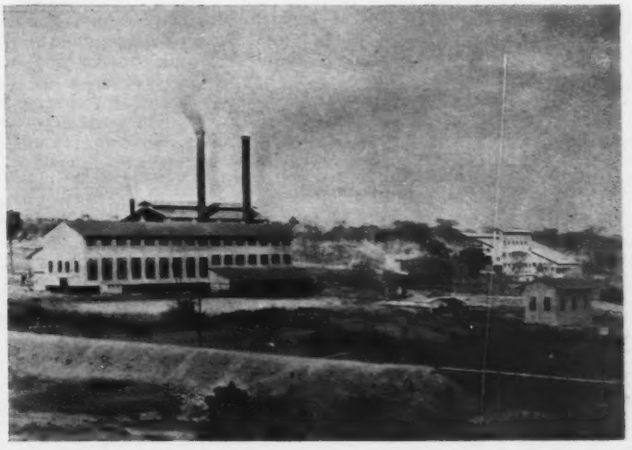
■

Ship Equipment to Fresno Mine

L. W. Swenson, of Fresno, Calif., is shipping a sectionalized Rib-Cone milling plant, together with Overstrom tables and Straub crusher, to his mine, 45 miles east of Fresno. This equipment is to treat a high-grade, free-milling gold ore.

At the left is the Symons cone crusher section of Roan Antelope, as it appeared at the end of August, and at the right is the power plant of this Northern Rhodesia enterprise. Production of 5,000 tons of copper ore daily is expected to be attained about the end of 1931





Prepare to Block Out Ore at New Guinea Gold Fields

"Having now proved the existence of valuable gold ore for an aggregate length of over 8,000 ft. on the plateau, our most pressing problem is the blocking out of ore reserves and proving the nature of the ore in depth," Leslie Urquhart, chairman of Mining Trust, stated at the annual meeting of the company in London in connection with development of the New Guinea Goldfields area, near Wau, New Guinea. "Owing to the configuration of the country, we are unable to reach the unoxidized ores by driving adits of a reasonable length and are therefore obliged to do our development work from shafts. This requires the installation of pumps and adequate power plant, for which preparations are being made.

"In the meantime, diamond drilling has been commenced to ascertain the nature of the unaltered ore below water level. In two or three places we have reached the ore below water level and have been able to secure samples of sulphide ore before being flooded out. The assays of this ore were very high and appear to confirm Mr. Kingsbury's theory of the existence of bonanza ore in a zone of secondary enrichment.

"The great amount of work which we have done in the oxidized zone, while it has not blocked out large reserves of ore, has been of great service in proving the regularity of the veins and the consistency of their precious-metals contents, and I am convinced that the estimate which I made in my last speech to you—namely, 182,000 long tons of a gross value of £765,000 per 100 ft. of depth—will prove to be a conservative estimate of the reserves of oxidized ore in this area alone."

In the lower area, 3,000 ft. below the plateau, the last cables received report striking 36 in. of ore at a depth of 130 ft. that assay 225s. to the ton. This is at Location 14. An additional 70 in. averaging 110s. has been cut. Above this vein, the flat orebody has been proved to contain 100,000 tons averaging more than 110s. Recent milling tests have indicated a recovery of 98 per cent of the gold content.

The company will lease certain alluvial claims on the lower area, from which it expects to derive an income of £4,000 monthly after January. By leasing these claims, the banks of the streams will be opened up, with a probability of disclosing further veins. The exploration and drilling program now under way will cost about £9,000 monthly, according to estimates of the management. New Guinea Goldfields has cash reserves of £174,000 and is owed £356,000, as and when required, by Mining Trust.

■

Park City Con. Shipments Up

Shipments of lead-zinc-silver ore from the Park City Consolidated property, in the Park City district of Utah, were 3,192 tons in September, all of which came from development work. The company is blocking out ore on the 900 and 1,000 levels. At the 900, ore has been proved for a length of 650 ft. over widths of 4 to 5 ft., and on the 1,000 level 250 ft. of drifting in ore has been done to date. On the 400 level the company is developing another vein called the East Crescent.

Trend of the Times

BUSINESS is bearing up as well as can be expected under the weight of the wave of uncontrolled deflation which financial fatalism and lack of business statesmanship in this country let loose upon the world in the third quarter. . . . There is a marked shortage of bear food in this week's crop of statistics, and signs multiply indicating that business as a whole is not getting worse and is making definite improvement—too slow to warrant any high hopes of quick recovery this year, but steady enough to justify those looking and planning ahead for next year. . . . *The Business Week* index has risen again, for the fifth consecutive week, from 87.1% to 87.5% of normal, reflecting chiefly continued expansion in general trade and a level of building sustained above seasonal expectations. . . . Increased consumption of electric power in manufacturing during September, with some gain in employment and payrolls, indicates a fair seasonal resumption of industrial activity. . . . A further rise in foreign trade in September, with record exports of cotton, offers some encouragement in face of increased uncertainties abroad. Sharply rising orders for machine tools for the second consecutive month show that some industries, at least, think these States still have a future, and are unwilling to join the procession of economic crustaceans who are trying to teach the country to walk backward. . . . Bears can be—and are being—tamed, but what can be done with the crabs?
—From *The Business Week* of Oct. 22.

Mexico May Change Practice in Exporting Gold Output

Upon request of the Secretary of the Treasury, the Bank of Mexico has withdrawn 10,000,000 silver pesos from circulation, in an effort to stay the downward rate on the local exchange. The Mexican government is also considering a plan to require mining companies exporting products containing gold, to return to Mexico the value of the exported gold, in New York drafts, payable at par. A commission of financial experts is now working on a general plan to relieve the situation brought about by the slump in silver and other metal prices.

■

Gould Leases Wilshire Mine

H. W. Gould & Company, of San Francisco, has taken over, under bond, the old Wilshire mine, in Inyo County, Calif., which is owned by Bishop Creek Milling. The new operators will install pumps and drain the mine to the 300 level, on which most of the development work was formerly done. The ore is a complex gold-bearing iron pyrite, with copper and silver. A 75-ton flotation plant was in operation on this property in 1921 and 1922. Concentrate was shipped to the Midvale plant, in Utah, for smelting.

■

Michigan Shaft Down to 1,350 Ft.

Mohawk, which is sinking "E" shaft of its Michigan mine property, in Ontonagon County, Mich., will begin opening and developing the Butler lode early in the coming year. The shaft, which is going down in the footwall of the vein, has about 450 ft. more to go to reach the 1,800 level, the present objective. The 1,350 level has been reached and the shaft is again in regular ground, after passing through a somewhat broken area.

■

Closing of Baltic Marks End of $2,000,000 Program

Though the Baltic mine will soon follow Trimountain into idleness on account of the low price of copper, neither of these properties, in the Michigan district, owes Copper Range anything. They have shown a combined loss in the last ten years of more than $2,000,000 through operation, exploration, and development work, but prior to that they had earned about $17,000,000. Baltic's total profits up to 1920 were about $14,000,000; Trimountain's excess of receipts over expenditures was about $3,000,000.

Baltic's performance fully justified the work undertaken in the last ten years. The development and exploration of the mine at depth during that period, however, proved that the original deposit continued below the No. 25 level at the south end of the mine only, and for a length too short to permit of profitable operation. Work done in Trimountain was justified by the regularity of the lode and its location, just north of the Champion ore deposit which extends virtually to the boundary line.

In Baltic, diamond drilling below the bottom workings has indicated ore at greater depth, which may be opened at some future time. No drilling has been done in Trimountain, but drilling may be done later to learn the character of the Baltic formation at greater depth and also test the Isle Royale lode. Should favorable results be encountered, access for further development would be possible from the adjoining Champion workings at such time as these reach sufficient depth.

EXCLUSIVE

CABLES

FROM CORRESPONDENTS IN THE PRINCIPAL MINING CENTERS

San Francisco Mines Shows Big Drop in Earnings

London, Oct. 17.—The operating profit of San Francisco Mines of Mexico, large lead-zinc producer operating in Chihuahua, Mexico, was £143,690 in the fiscal year ended Sept. 30, 1930, compared with £415,267 in the preceding fiscal year. Assuming that write-offs will be on about the same proportion as last year, when the net profits were put at £335,589, the net earnings this year will be about £115,000, which makes available for dividends only 15 per cent, compared with declarations of 37½ per cent last year. As the company's balance brought forward at the end of last year was £172,564, however, the financial position is sound, and possibly payment of more than 15 per cent will be made. The drastic drop in profits is entirely due to low metal prices, as production was increased.

. . . . A new agreement has been concluded between the producers, the government of the Union of South Africa, and the diamond syndicate to replace the old agreement for sales of the gems. The old agreement expires in December. De Beers Consolidated, the largest factor in the trade, proposes to create 300,000 additional deferred shares of £2 10s. par.

. . . . South American Copper, operating properties at Aroa, Yaracuy, Venezuela, reports that copper extraction is still unsatisfactory. A new 200-ton flotation plant was put into operation last January to treat the complex ore, of which about 400,000 tons averaging 3.5 per cent copper has been proved. A new high-grade orebody, which will average from 6 to 7 per cent copper, has been discovered west of the existing workings.

. . . . St. John del Rey, Brazilian gold producer, operating the Morro Velho mine in Minas Geraes, reports that the revolution now in progress in that country has not interfered with operations. Revolutionary activities have been centering in Minas Geraes, and it was feared that production might be affected. Panama Corporation, which is developing non-ferrous metal properties in the Province of Veraguas, Brazil, announces a high-grade strike in its El Remance mine. Ore averaging £22 per ton over a width of 34 in. has been followed for a distance of 19 ft. to date.

. . . . Of 108 tin dredges, mostly in the Far East and Nigeria, that closed down for two months under the program of curtailment of the Tin Producers' Association, 52 are expected to remain inactive until the end of 1930. If expectations are realized, this will mean a real cut in alluvial production. South Crofty, one of the small Cornwall lode mines, which produces about 800 tons of tin concentrate annually, is closing down because of the low price.

. . . . Annual report of Russo-Asiatic Consolidated, just issued, states that no progress has been made toward the settlement of its claim of £56,000,000 against the Soviet government. As the company's other interests have been transferred to Mining Trust, its future is not too bright.

. . . . Transvaal platinum share prices continue to dwindle, and little is heard of the industry. The Onverwacht Company's fifth annual report brings to a close the history of this dunite "pipe," for all its ore is now exhausted (at 975 ft. depth) and mining suspended. In 51 months' life, the mine produced 108,580 tons of ore and the mill treated 113,650 tons (including alluvial), for a total yield of platinum and allied metals of 27,630 oz., or 4.87 dwt. per ton. The average price realized for this period was £12 per ounce, against costs of approximately £7. Dividends totaling £146,250 were paid, or 32½ per cent of the company's issued capital.

■

Rand Annual Reports Indicate Improved Ore Reserves

Johannesburg, Oct. 16.—Three annual reports of gold-mining companies operating in the Transvaal have been issued within the last few days. They are, on the whole, satisfactory statements, both from the standpoint of finances and of ore reserves. The companies covered are Consolidated Main Reef, which is on the Central Rand; New Modderfontein, on the Far East Rand; and Sub Nigel, at Heidelberg, southeast of the Rand.

. . . . The most satisfactory feature of the Sub Nigel report is the high grade of the ore now being opened up in the lease area, south of the company's original holdings, as compared with the normal grade on the old areas. This is a general indication that the grade of ore is improving with depth, as the reef dips to the south.

. . . . The position of New Modderfontein, which has been the subject of much discussion among mining men and investors, is frankly and clearly stated in the annual report. Although the shares have shown a tendency to weaken on the exchange since the report was issued, the mine is nevertheless in a sound position by virtue of the satisfactory ore reserves and the excellent possibilities of development work on the upper leaders of the south reef.

. . . . Directors of Consolidated Main Reef, which is one of the higher-cost properties on the Central Rand, anticipate lower workings costs in the future. Recently, costs at Consolidated Main Reef have been about 25 to 26s. per long ton, compared with the average of about 19s. for the entire district. A reduction in costs will not only mean an increase in profits, but it will enable a further increase in ore reserves, which are now almost sufficient for three years of operation at present milling rates. Good development results are reported in the official statement.

Two R.C.B.C. Holes Cut Ore; Shaft Sinking Started

London, Oct. 17.—Two new diamond-drill holes that were put down by Rhodesian Congo Border Concession in its West Extension area, adjoining N'Changa Copper, in Northern Rhodesia, have cut ore. They are Nos. NE 41 and 43. Of these the latter is on the southwestern edge of the high-grade oxide-sulphide orebody under development at the R.C.B.C. and N'Changa properties. It cut ore at a depth of 260 ft. and showed a total of 50 ft. averaging 8.08 per cent copper, largely oxide. No. NE 41, almost due north of NE 43, cut the River Lode horizon at a depth of 430 ft. and has so far shown 40 ft. averaging 7.16 per cent copper, of which more than half is sulphide. Three shafts are now being sunk by R.C.B.C. and N'Changa to develop the orebody, which has been estimated to contain as much as 65,000,000 tons of 7 to 8 per cent copper ore. The three shafts will be connected by drives and the deposit will probably be worked jointly, as it overlaps the boundary separating the two properties.

. . . . Production of copper by Bwana M'Kubwa Copper was the equivalent of 690 short tons of refined copper in September. This is somewhat higher than the average of recent months and indicates that the company is probably working its plants at capacity to keep costs down. At the N'Kana property, the pilot plant is being operated regularly on ore from development work. Good progress is reported in construction of the large concentrator. Drill hole No. 34 in the Mindola section has been completed in ore. It cut 18.5 ft. averaging 5.35 per cent copper at a depth of 1,600 ft. This hole is one of the series that is being put down to determine the character of the orebody at depth. Very little additional drilling is being done at N'Kana, as the tonnage already outlined is ample for the plant being built.

. . . . In September, the total amount of new development work done in Roan Antelope was 5,139 ft., which compares with the previous record of 3,882 ft. driven in August. The September openings were nearly double the footage called for in the company's schedule and indicate that the date of starting production may be advanced.

. . . . Extension of the railroad from Benguela, on Lobito Bay, to the Belgian Congo to unite with the transportation system of Union Minière du Haut-Katanga will be completed by the end of January, according to an announcement. This line will give the copper district an outlet to the west coast of Africa, thus doing away with the necessity of shipping copper by the east coast, the Suez Canal, and the Mediterranean.

. . . . Output of electrolytic zinc by Rhodesian Broken Hill was 1,438 long tons in September, or about 90 per cent of capacity.

MARKET AND FINANCIAL NEWS

World's Production of Copper Increased in September

World's production of copper during September totaled 151,005 tons, against 149,843 tons in August, and 174,135 tons in September, 1929, according to the American Bureau of Metal Statistics. The daily rate for September was 5,034 tons, against 4,834 tons in August, and the previous high for the year of 5,027 tons in January last. Production statistics, by countries, in short tons, follow:

	Aug.	Sept.
United States	66,698	68,487
Mexico	4,812	5,078
Canada	12,850	12,015
Chile and Peru	26,937	26,374
Japan	7,314	7,590
Australia (*b*)	1,548	1,832
Germany	5,784	5,429
Other Europe (*a*)	11,200	11,500
Elsewhere (*a*)	12,700	12,700
Totals (*b*)	149,843	151,700

(*a*) Partly estimated. (*b*) Revised.

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Stocks of Refined Copper Increased 12,962 Tons

Stocks of refined copper in the hands of North and South American producers on Oct. 1 amounted to 360,650 tons, an increase of 12,962 tons contrasted with the figures released a month previous. Stocks of blister also showed a gain, the holdings of 237,135 tons being 3,000 tons larger than a month ago, according to the American Bureau of Metal Statistics. The net gain was about in line with expectations. Shipments of refined during September, though larger than in August, were disappointing.

The daily rate of production of refined copper for September was 3,867 tons, against 3,896 tons in August, and 4,478 tons in September, 1929. United States mine production was stepped up a little during September, the daily rate for the month being 1,886 tons, against 1,811 tons in August.

Stocks of blister and refined copper in the hands of North and South American producers at the beginning of September and October, in tons, follow:

	Sept. 1	Oct. 1
North America:		
Blister (*a*)	224,298	225,466
South America:		
In blister at smelters	3,762	4,945
In transit to U. S.	6,075	6,724
Blister, No. and So. America	234,135	237,135
Refined, No. and So. America	347,688	360,650
Grand totals	581,823	597,785

(*a*) Includes stocks at smelters, quantity in transit, stocks at refineries, and quantity in process at refineries.

Distribution of U. S. copper production in August and September:

	August	September
Porphyry mines	20,956	20,531
Lake mines	6,545	7,624
Vein mines	24,278	24,326
Custom ores	5,000	(*a*) 4,100
Total crude production	56,779	56,584
Daily rate	1,832	1,886
Smelter production	66,898	68,487

(*a*) Partly estimated.

Domestic and export shipments of refined copper, by months, for 1929 and the first nine months of the current year, in tons, follow:

	Shipments		
1929	Export	Domestic	Total
January	57,054	100,135	157,189
February	50,150	98,771	148,921
March	59,946	105,860	165,806
April	57,708	99,051	156,759
May	55,123	93,743	148,866
June	48,461	95,258	143,719
July	40,204	98,720	138,924
August	45,035	96,970	142,005
September	45,921	98,043	143,964
October	53,461	105,729	159,190
November	37,879	68,979	106,858
December	35,652	58,150	93,802
1930			
January	30,358	69,932	100,290
February	29,597	61,879	91,476
March	30,523	73,644	104,167
April	29,196	50,017	79,213
May	49,115	75,760	124,875
June	44,818	71,887	116,705
July	42,466	75,436	117,902
August	38,319	56,810	95,129
September	37,873	65,169	103,042

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Consolidated Mining's Output Up in Third Quarter

Production figures for the third quarter of 1930, issued by the Consolidated Mining & Smelting Company of Canada, reveal a slight decrease in lead and a fairly large increase in zinc tonnage, compared with the figures of output for the same period last year. Statistics follow:

Three Months Ended Sept. 30

	1930	1929
Lead, tons	36,846	38,680
Zinc, tons	28,802	21,221
Copper, tons	662	304
Gold, oz.	5,927	3,463
Silver, oz.	1,875,442	1,782,733

Output for the first nine months of the current fiscal year, with comparisons, follows:

Nine Months

	1930	1929
Lead, tons	112,287	110,345
Zinc, tons	85,959	66,688
Copper, tons	6,551	1,014
Gold, oz.	17,787	12,036
Silver, oz.	5,310,032	5,402,297

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UNITED VERDE COPPER, operating at Jerome and Clarkdale, Ariz., has received a tax rebate of $615,335 from the U. S. government because of overassessment in 1917, according to the Bureau of Internal Revenue.

Domestic Lead Production Down in September

Domestic production of refined lead during September totaled 48,491 tons, against 52,980 tons in August, and a monthly average for the first nine months of the year of 52,529 tons.

Statistics for August and September, as compiled by the American Bureau of Metal Statistics, in tons, follow:

Production:	Aug.	Sept.
From domestic ore	52,980	48,491
Secondary and foreign	5,056	4,746
Total production	58,036	53,237
Stock at beginning (*a*)	62,880	72,832
Total supply	120,916	126,069
Stock at end (*a*)	72,832	73,669
Shipments by difference	48,084	52,400
Shipments reported	47,979	52,451

(*a*) Domestic only.

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Financial Notes

CERRO DE PASCO COPPER, operating copper, lead, and silver mines in Peru, has declared a quarterly dividend of $1 for the last quarter of 1930. The company had been on a basis of $6 annually, but the drop in metal prices has forced a reduction in payments.

BRADEN COPPER, operating properties near Rancagua, Chile, has been ordered to pay 10,000,000 Chilean pesos for infraction of the law providing for the use of stamped paper and government document stamps, according to reports of the United Press. Appeal to a higher court has been made.

MCINTYRE PORCUPINE MINES, operating a gold property in northern Ontario, reports net earnings, before depreciation, of $542,241 in the quarter ended Sept. 30, compared with $484,035 in the preceding quarter. Revenue for the first six months of the current fiscal year is therefore $1,026,276, compared with $939,543 in the same period last year. Production shows an increase of $189,961 to $2,365,433.

MAGMA COPPER, operating properties in Arizona, reports net earnings, after depreciation, but before taxes, of $193,483 in the third quarter of 1930, based on a net selling price of 10.408c. a pound for copper. In the second quarter, net earnings were $222,737, based on a price of 12.2875c. Costs per pound of copper produced have been cut from 9.51c. a pound to 7.83c. a pound. Production dropped from 8,028,977 lb. to 7,491,670 lb.

Mining Company Dividends for October, 1930

Companies in the United States	Situation	Per Share	Total Disbursements
Aluminum Company of America, pfd	Various	$1.50 Q	$2,214,930
American Zinc, Lead & Smelting, pfd	Various	1.50 Q	120,590
Bunker Hill & Sullivan, l. s	Idaho	0.50 MX	245,250
Bunker Hill & Sullivan, pfd	Idaho	1.50 Q	11,485
Cresson Consolidated, g	Colorado	0.01 Q	12,000
Eagle-Picher Lead, pfd., l. z	Oklahoma, Missouri	1.50 Q	12,770
Homestake Mining, g	S. Dakota	1.50 MX	376,740
Kennecott Copper	Various	0.50 Q	4,686,061
Magma Copper	Arizona	0.75 Q	306,116
Newmont Mining, h	Various	1.00 Q	452,760
Phelps Dodge, c	Various	0.75 Q	1,500,000
Silver King Coalition, s. l..s	Utah	0.15 Q	183,070
U. S. Smelting, Refining & Mining	Various	0.25 Q	121,587
U. S. Smelting, Refining & Mining, pfd	Various	0.875 Q	425,557
Companies in Other Countries:			
Dome Mines, g	Canada	0.25 Q	238,333
Hollinger Consolidated Gold	Canada	0.05 M	246,000
Howe Sound, c. l. z	Mexico, Canada	1.00 Q	496,038
N. Y. & Honduras Rosario, g. s	Honduras	0.37½ Q	75,000
Nipissing, s	Canada	0.075 Q	90,000
Noranda Mining, c. g	Canada	0.50 Q	1,119,500
Premier Gold, s. g	Canada	0.06 Q	300,000
Total			$13,221,017

c, copper; s, silver; l, lead; z, zinc; g, gold; h, holding; Q, quarterly; M, monthly; X, extra.

Ontario's Gold Production Up During September

Production of gold by the mines of Ontario, Canada, was put at $2,925,589 in September, compared with $2,702,334 in the corresponding month of 1929, and $2,721,563 in August, 1930. The tonnage milled was 322,899 tons, compared with 342,297 tons in September, 1929. Kirkland Lake reported a larger production than Porcupine, although both camps showed a notable improvement in grade.

For the first nine months of 1930, gold output from northern Ontario has totaled $26,213,324, compared with $24,726,698 in the corresponding period of 1929. The tonnage treated has been smaller, the increase in value being due to the relatively larger proportion of ore mined at Kirkland Lake. Production for the remaining three months of 1930 is expected to show a substantial gain, as the new Dome mill will probably be started and Lake Shore is increasing its tonnage almost 50 per cent.

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Further Curtailment in Tin Production Announced

Further curtailment of tin-producing operations has been announced by the Tin Producers' Association in London, together with a statement that the results of the restriction of output during the quarter ended Sept. 30 had fully come up to its expectations. The reduction for the quarter amounted to 7,900 tons, compared with the record for the same period last year. In reply to the disturbing reports which upset the tin market about a week ago, the association announced that there had been no secessions from its membership, nor had any question arisen as to the discontinuance of regulation of production agreed upon.

Though Frank E. Mair, prominent tin producer, has resigned from the council and executive committee of the association, it was stated that his resignation would not affect the adherence to the association of the several companies of which he is chairman of the board.

Statistics showing production of tin during the third quarter of the current year, with a comparison, in long tons, follow:

	Third Quarter 1930	Third Quarter 1929
Federated Malay States exports	13,708	16,743
Unfederated Malay States exports	402	586
Imports into Straits settlements	7,302	8,193
Cornish production	662	748
Nigerian arrivals	1,742	2,213
Bolivian shipments	8,418	11,090
Banka shipments	2,641	3,138
Australian shipments	5	140
Totals	34,880	42,851
Chinese shipments	856	870
Total	35,736	43,721
Sundry imports into United Kingdom	1,260	1,175
Totals	36,996	44,896

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JOHANNESBURG CONSOLIDATED INVESTMENT, South African holding company with interests in gold and diamond properties, reports a net profit of £565,192 in the year ended June 30, 1930, compared with £593,199 in the previous year. The company has increased its holdings in North Rhodesian copper companies.

NEW YORK & HONDURAS ROSARIO MINING, operating a silver-gold property in Honduras, has declared an extra dividend of 12.5c. a share.

American Metal Adds to Its Rhodesian Copper Holdings

In accordance with its previously outlined policy, American Metal has acquired from Canadian Selection 800,000 English ordinary shares of Roan Antelope Copper and 1,000,000 ordinary shares of Rhodesian Selection Trust in exchange for 350,000 shares of common stock of American Metal, issued from the treasury of the latter, and $1,000,000 in cash. These 350,000 shares will not be entitled to dividends until on and after Dec. 1, 1932. Application has been made to the New York Stock Exchange for the listing of the 350,000 shares, to become effective Dec. 1, 1932. Canadian Selection is the successor to Selection Trust.

Roan Antelope, in Northern Rhodesia, is expected to begin producing during the second half of 1931, and its first unit is expected to reach full operation within a few months after commencement of production. Rhodesian Selection Trust owns a two-thirds interest in special grants covering about 140,342 acres of the N'Kana Concession in the Northern Rhodesia copper belt and also owns approximately 65 per cent interest in Mufulira Copper Mines. The Mufulira mine is now being equipped and is expected to reach production during the latter part of 1932. Both Mufulira and Roan Antelope concentrates will be treated at the smelter now being constructed at Roan Antelope. The product will in whole or in part be sold as a fire-refined copper of high quality. Plans for the erection of an electrolytic refinery in England in association with other Rhodesian mining companies have been discussed, but have not yet matured.

A. Chester Beatty, of London, who has been identified with the development of the Roan Antelope and Rhodesian Selection Trust properties, has consented to join the board of American Metal at an early date.

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SOUTHERN RHODESIA BASE METALS, operating the Alaska copper property in Southern Rhodesia, reports a loss of £10,106 in the year ended March 31, 1930. Copper concentrate sold was valued at £20,112 and stock of copper concentrate on hand and in transit at the end of the year was put at £9,000.

Silver Production Statistics

Silver production, in thousands of ounces, as compiled by the American Bureau of Metal Statistics, and classified according to countries, follows, for nine months of 1930:

	U. S.	Canada	Mexico	Peru	Australia	Burma	Total
Jan	4,753	1,716	5,877	1,549	780	609	15,284
Feb	5,161	1,225	12,717	1,482	656	608	21,849
March	4,998	1,714	8,844	1,460	720	607	18,343
April	4,627	1,705	7,514	1,467	646	611	16,570
May	4,293	1,585	9,080	1,959	712	608	18,237
June	3,969	1,485	10,276	1,527	740	610	18,607
July	3,551	2,100	7,905	1,480	897	580	16,513
Aug	3,835	2,685	(a)	1,550	945	580	(a)
Sept	3,717	3,486	(a)	1,495	627	(a)	(a)

(a) Not yet available.

World Conditions in Zinc Show No Improvement

INTERNATIONAL METAL SERVICE, LTD.
London

September has been the reverse of a pleasant month for all connected with zinc, save, of course, those operators on the markets who take a consistently "bearish" view of the outlook.

During the first half of the period under review offerings of metal were not excessive, so that the London market was able to hold fairly steady at a shilling or so either side of £16 in the case of current month's shipment. As has been the case on your side of the Atlantic, however, it has been due to the ability of producers to keep off the market more than to any other cause that this apparent steadiness continued, as buying demand was exceedingly meager and speculative support was practically non-existent. It was the opinion that, despite anything that Belgium might be doing in the matter of curtailment of output, the steps being taken in other countries were not sufficient and that even now stocks of slab zinc were accumulating, and the weakness of sentiment may be judged from the fact that—though the current month was holding up fairly well—the third-month position was losing ground steadily. Thus, for a whole week September held at £15 18s. 9d., but in that period December dropped from £16 7s. 6d. to £16.

As the month drew to a close sentiment deteriorated. The prime factor in starting markets on the downhill path again was really the renewed weakness in copper, but, once having been given the opening, "bears" were not slow to take advantage, and were helped by tired holders trying to get out of their commitments. This does not apply solely to zinc. All the metals were equally affected, and for the last week of the month the London market seemed to be almost panic stricken. On the last day of September slab zinc was selling at £14 15s. a ton, the lowest level in 30 years.

In present circumstances it is rather difficult to find anything cheerful to write about zinc. That the price is tragically low goes without saying, and really it hardly seems credible that it can slip down much farther; but this argument has been proved wrong so many times during the last few months that even today no one would place much faith in it. There are a few speculative dealers who have taken a risk and bought zinc since the turn of the month, but consumers are not evincing much interest, and, as is the case in other industries, they are in no mood to increase their scale of buying until they can see a better influx of orders for their own products.

For the time being there is obviously plenty of metal for all needs; Germany even reports an increase in stocks—and it is certain that there has been some free selling from that quarter on the market just lately—so that, although those in the best position to know are confident that the situation is slowly improving, there is little outward evidence of such betterment in the statistical position, and it is upon such outward evidence that the market is likely to judge.

The market might be helped a little if only Belgium could be persuaded to revert to her old practice of issuing details of her output. In the case of Holland, the production is negligible from the point of view of any effect curtailment of output there could have on the general position. Somehow, it is not thought that Poland is doing much in the matter of reducing production, but appearances are certainly in favor of the tonnage from Belgium being substantially less than was the case a few months ago. But of definite knowledge there is none, and the published figures for August from the other countries show that they are making no effort to get production down to the level of demand; apparently they are still hanging on in the hope that business must soon improve.

As to the chance of this much to be desired happening becoming more than a hope in the near future, the outlook is not rosy. British galvanizers made a cut of 5s. per ton in their price for 24-gage sheets in mid-month, but do not seem to have reaped much benefit therefrom as yet. The Continental galvanizing trade is not doing any too well, and the industry on your side of the Atlantic is in no better condition. Brass makers, with notable exceptions here and there, are complaining of poor business, and the slackness of the building trade on the Continent presupposes that rollers are by no means happy. Even from France there are now coming reports of a falling away in industrial activity. Taken on the whole, it does not look reasonable to expect any great increase in consumptive demand during the next month or so, which means that zinc may still have to pass through a trying period up to the end of the year. At the same time there cannot be any doubt that zinc at under £15 seems a real bargain, and it will be a matter for considerable surprise if there be not some better buying.

The only trouble is that, if consumers are cautious and cover their needs and a little surplus with care, they will obviously be in a position to keep off the market for a while on any marked sign of a recovery.

There has been no word at all as to the success of the negotiations which the interests favorable to the re-establishment of the zinc cartel were understood to be conducting with the producers who were not convinced of the efficacy of such an organization, but nobody seems to worry much about this; much more reliance is placed on the increasing stringency in ore supplies.

World stocks of zinc on Oct. 1 were estimated as follows:

	Metric Tons
United States	120,700
Canada	8,800
Germany-Poland	18,300
Belgium	11,800
France	3,600
Great Britain	12,800
Other Europe	3,500
Australia (including afloat)	14,500
Far East	2,800
Elsewhere	2,400
Total	199,200

Estimated stocks on Sept. 1 were 190,700 metric tons.

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Aluminum Cartel Lowers Price

The European aluminum cartel on Oct. 16 announced a reduction in the price of aluminum to £85 per ton, a decline of £10 from the former selling basis. This is the first revision in the price since June, 1928. Demand for aluminum in European markets, for home as well as foreign consumption, has been disappointing for some time.

Complete Market News and Prices

THE semi-monthly magazine you are now reading carries only a condensed review of important market news and price movements. For buyers and sellers of ores, metals, minerals, and scrap who require reliable information as soon as it is available, we now provide *Metal and Mineral Markets*, which goes to press at the close of the metal-market week each Wednesday. It is printed at high speed and is in the mails that evening. In compact form, ready for insertion in a ring binder, it is ideal for desk and reference use. It carries the standard *E.&M.J.* quotations used in contracts the world over, recognized as authoritative and dependable. *Metal and Mineral Markets* is priced to subscribers in the United States and its possessions at $2 per annum; to countries in the Americas but outside the United States, $5; elsewhere, $10 yearly: 52 issues. Address *M.& M.M.*, 36th St. and 10th Ave., N.Y.City.

Good Tonnage of Copper Sold at 10c.—Lead, Tin, and Zinc Prices Lowered

New York, Oct. 16, 1930.—A substantial tonnage of copper was sold on the 10c. basis in the last two weeks, the total foreign and domestic business exceeding 65,000 tons. This appeared to stabilize the price, though the undertone toward the close was anything but firm. Lead prices lost ground on continued unsettlement in London, but some good buying developed on the decline. Liquidation by London speculators in tin forced the price of that metal down below 25c., the lowest price in 28 years. Zinc business was disappointing, and, on freer offerings, the price dropped below 4c., East St. Louis. Quiet prevailed in antimony, quicksilver, and the metals in the platinum group. Silver was steady.

Copper Price Holds

Sufficient business was placed in copper to steady the market on the basis of 10c., delivered Connecticut, with all producers holding out for this price. Most of the producers were not inclined to consider bids on 1931 business, but several operators took on a good tonnage for first quarter of 1931 delivery. In the week ended Oct. 8 the domestic sales amounted to about 38,000 tons. In the week following, however, sales fell off sharply. The publication of the September copper statistics did not help matters any, even though the gain in stocks had been largely discounted. With the business outlook still clouded, further curtailment in production appears inevitable in order to bring about a change for the better.

Lead Cut to 5.10c.

Under pressure of lower prices in London, producers here announced four reductions in the price of lead. The first change occurred on Oct. 4, when the American Smelting & Refining Company announced a reduction of 10 points in its contract price, establishing the New York quotation at 5.25c. This price held until Oct. 8, when a decline of 5 points brought the price down to 5.20c. Five-point reductions also were announced on Oct. 9 and 10, making the final quotation 5.10c. Similar price reductions were announced in the St. Louis market, and the final price for the period in that territory was 4.95c. Buying remained quiet until the London price showed signs of steadying. As soon as the foreign price firmed up, domestic consumers took hold well.

Zinc Price Reduced

Prime Western zinc settled at 3.95@4c., East St. Louis, a decline of slightly more than 25 points for the period and the lowest price named since 1901. The volume of business was disappointing, consumers showing only a mild interest in the lower prices. The September statistics of the American Zinc Institute estimated the stocks of zinc in the hands of producers on the last day of that month at 132,947 tons, against 122,635 tons a month previous. Domestic shipments fell far short of expectations, the total for September being 30,162 tons, against 35,758 tons in August.

Tin Down to 24.65c.

Tin prices declined to the lowest point in 28 years on forced liquidation by London operators who had been hanging on desperately for some time in the hope that the curtailment in production would result in some improvement in the situation. According to reports received here, the selling was by holders of tin outside of the group. The decline in the other metals, together with the unfavorable political and business developments on the Continent, started the selling movement. American consumers bought heavily on the decline and there was little reason to doubt that much of the distressed tin has been transferred to stronger hands. The low point in the domestic market was reached on Oct. 14, actual business passing on that day at 24.65c. per pound for prompt Straits. London sold down to £109 5s. on Oct. 10. Reports to the effect that the Tin Producers' Association was about to break up were officially denied. Restriction of output of tin during the third quarter of the current year is estimated at 7,900 tons, contrasted with the returns for the same period last year.

Silver Steady

Demand for silver was moderate throughout the last two weeks, but in the absence of any selling pressure the market was steady. Production of silver by Mexico in July amounted to 7,905,000 oz., against 10,276,000 oz. in June. The United States produced 3,717,000 oz. in September, against 3,835,000 oz. in August. Output of silver in Canada was 3,486,000 oz. in September, a gain of 801,000 oz. from the August level.

Other Metals

Quotations cover wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., delivered, Alcoa commercial and mill ingot, 99 and 98 per cent, 23.30c.; Alcoa No. 12 alloy, 22c.; metallurgical ingot, 94 per cent plus, 23.30c.; 98@99 per cent, 22.90c. London price reduced on Oct. 16 to £85, less 2 per cent, per long ton, for 98 per cent ingots and bars. Demand in London has been dull.

ANTIMONY—Per lb., duty paid, Chinese, spot, 7¼c.; futures, 7⅛c. Cookson's "C" grade, spot, 12⅞c. "C.M.C." grade, 99.9 per cent, spot. 10¾c. London, Chinese, spot, £26 15s. per long ton.

BISMUTH—Per lb., in ton lots, $1. London, 4s.

CADMIUM—Per lb., 70c. London, 2s. 6d.

CHROMIUM—Per lb., 97@98 per cent grade, 85@90c. per lb. contained chromium, maximum 1 or 2 per cent iron.

COBALT—Per lb., delivered: Metal imported from Belgium in the form of rondelles, 97@99 per cent, spot, $2.50. Discounts on contracts. London, spot, 10s. Nominal.

INDIUM—Per gram, minimum 99 per cent, $14@$15.

IRIDIUM—Per oz., $190@$200 for 98@99 per cent sponge and powder. London, £37@£39.

MAGNESIUM—Per lb., 12-lb. ingots (4x4x16 in.), 99½ per cent, 65c.@$1, depending on quantity; 2½- or 3-lb. sticks (1⅛ in.), 70c.@$1.05, depending on quantity. London, 2s. 9d.@3s. for 99 per cent ingots or sticks.

MANGANESE—Per lb. contained manganese, 95@97 per cent, 42c.

MOLYBDENUM—Per lb., in 50- to 100-lb. lots, C.P. powder, $9.50; 97 per cent, $6.50. (Usually sold as calcium molybdate or ferromolybdenum, which see.)

NICKEL—Per lb., ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.9 per cent), for single lots of spot metal. Contracts, 30@33c. London, per long ton, £170@£175.

OSMIUM—Per oz.. $60@$70. Nominal. London, £15½@£16.

PALLADIUM—Per oz., $22@$23. London, £3 15s.@£4.

PLATINUM—Per oz.: Official price of leading interest, $36. Market quiet but steady. Cash transactions between dealers and refiners at several dollars less. London, £6 10s.@£7. Average price of Colombian crude, basis 85 per cent platinum, for September was $27 per oz.

QUICKSILVER—Per 76-lb. flask, $110@$112, delivered. London, £22⅛.

RADIUM—Per mg. radium content, $50 in lots of 4 grams or more, to $65 for 1 gram; smaller quantities, $70.

RHODIUM—Per oz., $50. Nominal.

RUTHENIUM — Per oz., $45@$50. Nominal. London, £9½@£10.

SELENIUM—Per lb., $1.80@$2, depending on quantity, for black, powdered, 99.5 per cent pure. London, 7s. 8d.

SILICON—Per lb., minimum 97 per cent Si, maximum 1 per cent Fe, 15@17c.

Daily Prices of Metals

Oct.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
2	9.775	27.95	5.35	5.20	4.225
3	9.775	28.00	5.35	5.20	4.225
4	9.775	28.00	5.25	5.10	4.225
6	9.775	27.90	5.25	5.10	4.20@4.225
7	9.775	27.40	5.25	5.10	4.20
8	9.775	26.80	5.20	5.05	4.20
Av'ge	9.775	27.675	5.275	5.125	4.215
9	9.775	25.90	5.10@5.15	5.00	4.10
10	9.775	25.125	5.10	4.90@4.95	4.10
11	9.775	25.25	5.10	4.90@4.95	4.10
13	....	....	Holiday	....	....
14	9.775	24.65	5.10	4.95	4.00
15	9.775	25.50	5.10	4.95	3.95@4.00
Av'ge	9.775	25.285	5.105	4.950	4.055

Average prices for calendar week ended October 4, 1930, are: Copper, 9.775c.; Straits tin, 28.233c.; New York lead, 5.383c.; St. Louis lead, 5.227c.; Zinc, 4.231c.; and Silver, 35.729c.

Average prices for calendar week ended October 11, 1930, are: Copper, 9.775c.; Straits tin, 26.396c.; New York lead, 5.171c.; St. Louis lead, 5.017c.; Zinc, 4.152c.; and Silver, 35.896c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices of refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms or wirebars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight differential. The contract price for High-Grade zinc delivered in the East and Middle West is 1c. above the St. Louis price for Prime Western.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

Silver, Gold, and Sterling Exchange

Oct.	Sterling Exchange "Checks"	Silver		Gold London	Oct.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
2	4.85 11/16	35 3/4	16 7/16	84s 11 3/4d	9	4.85 11/16	36 1/8	16 5/8	84s 11 5/8d
3	4.85 11/16	36	16 5/8	84s 11 3/4d	10	4.85 5/8	36 1/8	16 11/16	84s 11 5/8d
4	4.85 3/4	35 3/4	16 1/2	....	11	4.85 11/16	35 3/4	16 5/8	....
6	4.85 3/4	35 3/4	16 7/16	84s 11 5/8d	13	Holiday	Holiday	16 3/4	84s 11 1/2d
7	4.85 3/4	35 7/8	16 9/16	84s 11 5/8d	14	4.85 9/16	36 1/8	16 13/16	84s 11 5/8d
8	4.85 5/8	35 3/4	16 1/2	84s 11 5/8d	15	4.85 9/16	36	16 11/16	84s 11 1/2d

Average of week ended October 8: Silver, 35.813c.; Sterling Exchange, $4.85729.
Average of week ended October 15: Silver, 36.025c.; Sterling Exchange, $4.85625.

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis of 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-sixteenths cent premium.

London

Oct.	Copper		Electrolytic	Tin		Lead		Zinc	
	Standard								
	Spot	3 M		Spot	3M	Spot	3M	Spot	3M
2	44 5/8	44 1/2	46 1/2	124	125 5/8	16 7/16	16 5/16	14 5/8	15 1/8
3	43 15/16	43 7/8	46 1/2	123 3/4	125 1/4	16 7/16	16 1/2	14 11/16	15 1/4
6	44 9/16	44 9/16	46 1/2	124 5/8	126	16 9/16	16 1/4	14 11/16	15 5/16
7	43 7/8	43 7/8	46 1/2	122	123 1/2	16 1/8	16 1/8	14 1/2	15
8	43 9/16	43 9/16	46 1/2	119 1/4	120 3/4	15 3/4	15 5/8	14 1/16	14 5/8
9	43 1/4	43 1/4	46 1/2	115 5/8	117 1/4	15 1/2	15 1/4	13 15/16	14 1/2
10	42 9/16	42 9/16	46 1/2	109 1/4	110 3/4	14 15/16	14 15/16	14	14 1/2
13	42 13/16	42 13/16	46 1/2	113 1/2	114 3/4	15 5/8	15 9/16	14 1/8	14 5/8
14	42 1/2	42 1/4	46 1/2	109 1/2	111	15 5/16	15 1/4	14 3/16	14 11/16
15	42 1/4	42 9/16	46 1/4	110 1/2	111 3/4	15 3/8	15 3/8	14 1/4	14 3/4

Prices for lead and zinc are the official prices for the morning session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

TANTALUM—Per kilo, $128 for C.P. sheet. Slow.

TELLURIUM—Per lb., $2.

THALLIUM—Per lb., $12.50@$15.

TITANIUM—Per lb. in 50- to 100-lb. lots, 75 per cent, $5.

TUNGSTEN—Per lb. contained tungsten, 98 per cent, powdered, $1.55.

Metallic Ores

Prices in tons of 2,000 lb., or in "units" of 20 lb., unless otherwise stated.

ANTIMONY ORE—No sales reported. London, per long ton unit, 3s. 6d.@4s. for 60 per cent sulphide ore.

BERYLLIUM ORE—Per unit of BeO, minimum 11 per cent BeO, $4@$5, f.o.b. mines. Per lb. BeO contained, 40c., c.i.f. European ports.

CHROME ORE—Per long ton, f.o.b. Eastern shipping points, Indian ores, $19.50 for 46@48 per cent Cr_2O_3 ore, and $24 for 50@51 per cent ore. London, £4⅛ for 48 per cent Rhodesian, and £4½@£5¼ for Indian and New Caledonian.

IRON ORE—Per long ton, Lower Lake ports. Lake Superior ores:

Mesabi, non-bessemer, 51½ per cent iron, $4.50. Old Range, non-bessemer, $4.65.

Mesabi, bessemer, 51½ per cent iron, $4.65. Old Range, bessemer, 51½ per cent, $4.80.

Colorado, per long ton unit, f.o.b. mines, 20 to 23 per cent, 6½c. Steady.

Eastern ores, cents per unit, delivered at furnaces: Foundry and basic, 56 to 63 per cent, 10c.

Foreign ores, alongside docks Atlantic ports, cargo lots, cents per unit:

North African and Swedish, low-phosphorus, 10c.

Spanish and North African basic, 50@60 per cent, 9@9½c.

Swedish foundry or basic, 65@68 per cent, 10c.

Newfoundland foundry, 55 per cent iron, 9c.

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports, cargo lots, exclusive of duty: Brazilian, 46@48 per cent Mn, 25c.; Chilean, 47 per cent minimum, 30½c.; Indian, 48@50 per cent, 27@28c.; Caucasian, 52@55 per cent, 27@28c.; South African, 52@54 per cent, 27@28c., nominal. Inactive. Domestic, f.o.b. *Colorado* mines, 20 to 25 per cent, 30c. Steady.

Per ton in carload lots:

Chemical grades, powdered, coarse or fine, minimum 80 per cent MnO_2, Brazilian or Cuban, $60. Javan or Caucasian, 85 per cent minimum, $60. Domestic, 70 to 72 per cent, $60, f.o.b. mines.

MOLYBDENUM ORE—Per lb. of contained MoS_2, nominally 40@45c., delivered Pittsburgh. London, per long ton unit, nominal at 33s. for 80@85 per cent concentrate.

TANTALUM ORE—Per lb. Ta_2O_5, 75c.

for 60 per cent ore. Per lb., f.o.b. *New Mexico* mines, crude ore with minimum 40 per cent Ta_2O_5, 85c.; 35 per cent, 65c.

TIN ORE—No market in United States. London, returning charge on 60 per cent Bolivian, £10 per long ton; on 70 per cent Nigerian, £6 17s. 6d.

TITANIUM ORE — Per gross ton, ilmenite, 45@52 per cent TiO_2, f.o.b. Atlantic seaboard, $10@$12, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7 @$8. Rutile, per lb., guaranteed minimum 94 per cent concentrate, 10c.

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Chinese wolframite, $12.25, duty paid. Bolivian scheelite, $13, and domestic, $13@$14; both nominal. Crude low-grade ores, f.o.b. *Colorado*, $10 basis for 60 per cent WO_3.

VANADIUM ORE—Per lb. V_2O_5 contained, 27c., f.o.b. shipping point.

ZIRCON ORE—Per ton, 55 per cent ZrO_2, f.o.b. Atlantic seaboard, $40@$45 in 30-ton lots. Crude granular zircon, $70, f.o.b. Suspension Bridge, N. Y.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.
Tons of 2,000 lb. unless otherwise noted.

AMBLYGONITE — Per ton, f.o.b. mines, 8@9 per cent lithium oxide, $50@$60.

ASBESTOS—Per ton, f.o.b. Quebec mines, tax and bags included: Crude No. 1, $375@$475; crude No. 2, $275@ $325; spinning fibers, $150@$175; magnesia and compressed sheet fibers, $100@$135; various grades shingle stock, $45@$70; various grades paper stock, $32@$35; cement stock, $15@ $20; floats, $10@$12. Market dull despite the general decline in prices.

Per ton c.i.f. New York: Rhodesian crude No. 1, $350; No. 2, $275.

BARIUM CARBONATE (Witherite)—Per ton, 90 per cent, 200 mesh, $47; 100 mesh, $44.

BARYTES—F.o.b. mines, bags extra:

Georgia: Barytes ore, crude, $6.50 per long ton; shipments continue at about half of normal.

Missouri: Per ton, water ground and floated, bleached, $23, car lots, f.o.b. works. Crude ore, minimum 93 per cent $BaSO_4$, less than 1 per cent iron, $7; 1 per cent iron and 93 per cent $BaSO_4$, $6.50@$7, f.o.b. mines.

BAUXITE—Per long ton: Domestic ore, chemical, crushed and dried, 55 to 58 per cent Al_2O_3, 1.5 to 2.5 per cent Fe_2O_3, $7@$8.25, f.o.b. *Alabama* and *Arkansas* mines. Other grades, 56 to 59 per cent Al_2O_3, 5 to 8 per cent SiO_2, $6.50@$8, f.o.b. *Arkansas* mines. Pulverized and dried, 56 to 59 per cent Al_2O_3, 8 to 12 per cent SiO_2, $12@ $12.25, f.o.b. *Arkansas* mines; abrasive grade, crushed and calcined, 78 to 84 per cent Al_2O_3, $15@$17.50, f.o.b. *Arkansas* mines.

Per metric ton, foreign, c.i.f. Atlantic ports: Dalmatian, 50 to 55 per cent Al_2O_3, 1 to 3 per cent SiO_2, $4.50@ $6.50; one dealer reports $7 for material running 52@54 per cent alumina and 1.50 per cent silica; market fair. Istrian, 54 to 57 per cent Al_2O_3, 3 to 5 per cent SiO_2, $5.50@$7; French, 56 to 59 per cent Al_2O_3, 2 to 4 per cent SiO_2, $6@$8; 56 per cent Al_2O_3, 1.50 per cent SiO_2, $7; 58 per cent Al_2O_3, 3@4 per cent SiO_2, $6.50.

BENTONITE—Per ton, f.o.b. Wyoming mines, dried and crushed, in bulk, $8; in bags, $10. F.o.b. Chicago, selected air-floated, $25. Market fair.

BORAX—Per ton, carload lots, in bags, crystals, $56; granulated, $50; powdered, $57.50; f.o.b. shipping point.

[1]CELESTITE—Per ton in carload lots, 90 per cent $SrSO_4$, finely powdered, $27.

CHINA CLAY (KAOLIN)—Per ton, f.o.b. *South Carolina* mines, crude lump, No. 1, $4.50; crushed to ¼ in., $6; pulverized, $9. Dull trade.

Florida, washed and crushed, No. 1, $12.50; No. 2, $12.

Imported English, f.o.b. American ports; lump, $15@$25 in bulk.

EMERY—Per ton, f.o.b. *New York*, domestic crude ore, $10. Market normal. Other American ore, delivered to grinders, per gross ton, $15; Turkish and Naxos ore, $30@$35. F.o.b. *Pennsylvania*, in 350-lb. kegs, Turkish, Khasia, and Naxos grain emery, 6½c. per lb.; American, 3½@4c. Quiet with slow demand.

FELDSPAR—Per ton, ground: Canada, $22; New England, $21.50; Southern, $30; Trenton, $21; Western, $24.

Virginia, No. 1, 325 mesh, $18; 200 mesh, $15@$16; 160 mesh, $14; No. 1 glassmakers', $11. Market fair to good.

New Mexico: Crude clean No. 1 potash spar, $4.75; ground, $9.50.

FLUORSPAR—Per ton, f.o.b. *Kentucky* and *Illinois* mines:

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $17.25. Foundry lump, 85-5, $20. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. *Colorado* mines, 82-5, $12.75.

FULLER'S EARTH — Per ton, f.o.b. *Colorado*, $18, various finenesses to minus 90 mesh.

F.o.b. *Georgia*, 30 to 60 mesh, $18; 15 to 30, $16.50; 200 up, $10; 100 up, $7. Steady demand.

GARNET—Per ton, f.o.b. *New Hampshire* mines: crude or mill run, $45; unwashed grades, $85; washed, $125.

New York: Adirondack garnet concentrates, $85. Very poor demand.

Spanish grades, $60, c.i.f. port of entry.

GILSONITE—Per ton, carload lots, f.o.b. mines *Colorado:*

Selected grade, $33; seconds (mine run), $25.50. Market normal.

GRAPHITE—Per lb., f.o.b. *New York:*

Ceylon lump, 7½@8½c.; chip, 6@7½c.; dust, 2½@4½c.; Madagascar flake, 6@8c.

No. 1 flake, 8@16c.; fine ground, 5c. upward; amorphous, 3c. upward.

Crude amorphous graphite, $15@$35 per ton, according to grade.

GREENSAND—Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade, in carload lots, $20. No. 2 grade, $15.

GYPSUM—Per ton, f.o.b. mill, crushed rock, *Iowa*, $2.50; *Ohio* and *New York*, $3. Ground, *Ohio*, $4; *Iowa*, $6. Agricultural, $6@$7. Calcined $6@$9.

IRON OXIDE (See Ocher)—Per lb.: Standard Spanish red, 3@4½c.; domestic earth, 2@4½c.

KAOLIN—See China Clay.

LEPIDOLITE—Per ton, $50@$60 for ordinary grades. Nominal.

LIMESTONE—Per ton, f.o.b. shipping points, depending on location, either lump or crushed, 25c.@$1.75.

Agricultural, $1 up to $6 for crushed or pulverized. Prices depend upon source, purity, fineness, and method of packing.

MAGNESITE—Per ton, f.o.b. *California* steel mill points, dead-burned, $29. *Washington:* Dead-burned grain magnesite, $22.

MICA—Per ton, f.o.b. *New Mexico*, scrap, white, $21; off color, $18. Punch, white, for disks, per lb., 10c.; for washers, 8c. Good demand.

F.o.b. *New Hampshire*, roofing mica, $23; Christmas snow, $34; 40 mesh white, $40; 60 mesh, $48; 100 mesh, $60; 200 mesh, $75. Clean dry mixed bench and mine scrap, $13.

F.o.b. *North Carolina*, sheet mica: Punch, 4@6c.; 1½x2 in., 25@35c.; 2x2, 45@60c.; 2x3, 85c.@$1; 3x3, $1.40@$1.60; 3x4, $1.80@$2; 3x5, $2@$2.25; 4x6, $2.75@$3; 6x8, $3.50@ $3.75; 8x10, $5@$7.50. These prices apply both to No. 1 and No. 2 mica. Black-stained mica takes a discount of 10 to 25 per cent from this schedule. White North Carolina mica, 70 mesh, $60 to $80. Biotite, or black mica, $15 a ton, unground.

MINERAL BLACK—(Graphitic shale) —Per ton, 325 mesh, 75 per cent carbon, $22.50, f.o.b. *Virginia*.

MONAZITE—Per ton, minimum 6 per cent ThO_2, $60.

OCHER—Per ton, f.o.b. *Georgia* mines, $17.50 in sacks; $20 barrels; second grade, $10. Moderate demand. Buff clay, 98 per cent through 325 mesh, $18.

[1]Price furnished by Foote Mineral Company, Philadelphia.

F.o.b. *Virginia*, dark yellow, 300 mesh, 60 per cent ferric oxide, in jute bags, $19.50.

PHOSPHATE—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7.15; 75 per cent, $6.40; 74@75 per cent, $6.15; 70 per cent, $4.65; 68 per cent, $4.10. Firm.

Florida, pebble, domestic: 76@77 per cent, $6.50; 74@75 per cent, $5.50; 72 per cent, $4.50; 70 per cent $4. Quiet.

Tennessee, ground, 80 per cent through 300 mesh, 33 per cent P_2O_5, $11.80 per ton, bags extra. Quiet.

POTASH—Per ton, contracts:

	Bags	Bulk
Muriate of potash, 80@85 per cent, basis 80 per cent	$37.15	$35.55
Sulphate of potash, 90@95 per cent, basis 90 per cent	48.25	46.65
Sulphate of potash-magnesia, 48@53 per cent, basis 48 per cent	27.80	26.20
Manure salt, 30 per cent	22.15	19.15
Manure salt, 20 per cent	15.65	12.65
Kainit, 14 per cent	12.70	9.70

Prices are delivered to Atlantic ports. Discounts up to 4 per cent for early shipment. Spot prices, $1.25@$1.50 per ton higher than on contract.

PUMICE STONE—Per lb., in barrels, powdered, 2½@4c.; selected lump, 5@7c.

PYRITES—Per long ton unit of sulphur, c.i.f. United States ports, guaranteed 48 per cent sulphur, Spanish, 13@13¾c.

[1]QUARTZ ROCK CRYSTALS—Per lb. in ton lots, colorless, clear but flawed, pieces ¼ to ½ lb. in weight, 20c. Flawless, for optical purposes, four times above price; larger crystals still higher.

SILICA—Per ton, water ground and floated, in bags, f.o.b. Illinois: 325 mesh, $16@$40 for 92 to 99½ per cent grades. Dry ground, air-floated, 325 mesh, 92@99½ per cent silica, $14@$30. Market steady. Glass sand, f.o.b. producing plant, $1.25@$5 per ton; molding sand, 50c.@$3.50; blast sand, $1.75@$6.

[1]SPODUMENE — Per ton, $50@$60, depending upon lithium content.

[1]STRONTIANITE — Per ton, lump, in carload lots, minimum 88@91 per cent $SrCO_3$, $100.

SULPHUR—Per long ton for domestic market, $18 f.o.b. Texas mines; $22 for export, Atlantic ports. Firm but dull.

TALC—Per ton, carload lots, f.o.b. works, containers included unless otherwise specified:

New Jersey: Soapstone, ground, $10@$12. Market fair.

New York: Double air-floated, short fiber, 200 mesh, $13.75; 325 mesh, $14.75. September sales showed improvement.

Vermont: 99 per cent through 200 mesh, extra white, bulk basis, $8@$8.50; 97 to 98 per cent through 200 mesh, medium white, $7.50@$8. Packing in paper bags, $1 per ton extra.

Virginia: 200 mesh, $6.25@$8; 325 mesh, $9.50@$11.

TRIPOLI—Per ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh, rose and cream colored, $16. Double ground through 110 mesh, rose and cream, $18. Air-floated through 200 mesh, rose and cream, $22.50; mill run, $16.

Rolled Metals

COPPER—Per lb., sheets, hot-rolled, 19¾c.; wire, f.o.b. mill, 11¾c.

LEAD SHEETS—Per lb., full rolled, 8c. clipped, 8¼c.

MONEL METAL—Per lb., sheets, full finished, 42c.; rods, hot-rolled, 35c.

MUNTZ METAL—Per lb., rods, 16¼c.; plates, 19c.

NICKEL—Per lb., sheets, full finished, 52c.; rods, hot-rolled, 45c.

NICKEL SILVER—Per lb., sheets, 10 per cent, 24⅜@24⅞c.; 18 per cent, 27⅜@28⅛c. Wire and rods, 10 per cent, 27⅛c.; 15 per cent, 31⅝c.; 18 per cent, 35⅛c.

PHOSPHOR BRONZE—Per lb., sheets and rods, 5 per cent tin, 31⅛c.; wire, 5 per cent, 31⅝c.; 10 per cent, 37⅛c.

ZINC SHEETS—Per lb., 9½c., f.o.b. works; ribbon, 9c.; 7 per cent discount on orders for 18 tons or more.

Alloys

FERROCHROME—Per lb. of contained chromium, 4 to 6 per cent carbon, 66 to 70 per cent chromium, 11c., delivered, on contracts; spot, 11½c. Containing 2 per cent carbon, 65 to 70 per cent chromium, 17½c.; maximum 0.10 per cent carbon, 26c.

FERROMANGANESE — Per gross ton furnace; domestic and foreign, 78@82 per cent, $94@$99, contracts, depending on quantity. Spiegeleisen, 19@21 per cent, $33 for spot carloads.

FERROMOLYBDENUM—Per lb. of Mo, f.o.b. shipping point, 50@60 per cent Mo, $1@$1.10.

FERROPHOSPHORUS—Per ton, 18 per cent P, $91; electrolytic, 24 per cent, $122.50, f.o.b. *Alabama* and *Tennessee*.

FERROSILICON—Per gross ton, delivered, 50 per cent, $83.50; 75 per cent, $130; 14@16 per cent, $39, f.o.b. Niagara Falls, N. Y. Spot shipments $5@$10 per ton higher on 50 and 75 per cent grades.

FERROCARBONTITANIUM — Per ton, $160, f.o.b. producer's plant.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.10 f.o.b. works.

FERROVANADIUM—Per lb. of V contained, delivered, $3.15@$3.50.

SILICOMANGANESE — Per long ton, carload contracts, delivered, $135 for maximum 2½ per cent carbon; $145 for maximum 1 per cent carbon.

SILICON ZIRCONIUM—Per lb., 47@52 per cent Si, 35@40 per cent Zr, 18@21c.

ZIRCONIUM FERROSILICON—Per gross ton, 12@15 per cent Zr, 39@43 per cent Si, $103.50@$108.50.

Metallic Compounds

ARSENIOUS OXIDE (White arsenic)—Per lb., 4c., delivered, all positions. London, per long ton, £15¾ for Cornish white.

CALCIUM MOLYBDATE OR MOLYTE—Per lb. of contained Mo, 95c.

COBALT OXIDE—Per lb., black, 70@71 per cent contained Co, $2.10. London, 8s. for black; 8s. 10d. for gray.

COPPER SULPHATE (Blue Vitriol)—Per lb., in car lots, 4.10c. for either large or small crystals.

GERMANIUM DIOXIDE—Per gram, in 200- to 300-gram lots, $3.50.

SODIUM NITRATE—Per 100 lb., crude natural, in bags ex vessel, Atlantic ports, $1.92.

SODIUM SULPHATE (Salt Cake)—Per ton, bulk, f.o.b. works, $16@$18.

ZINC OXIDE—Per lb. in bags, in car lots: Lead-free, 6½c.; 10, 20 or 35 per cent leaded grades, 6¼c.; French red seal, in bags, 9⅜c.

ZIRCONIUM DIOXIDE—Per lb. in 100- to 500-lb. lots, 87 per cent ZrO_2, commercial, 50c.

Refractories

CHROME BRICK—Per ton, f.o.b. shipping point, $45.

FIRECLAY BRICK — Per M., first quality, $43, *Ohio, Kentucky, Central Pennsylvania;* second quality, $35@$38.

MAGNESITE — Brick, per ton, f.o.b. works, 9-in. straights, $65. Deadburned grain, $40, f.o.b. Chester, Pa., or Baltimore.

SILICA BRICK—Per M., *Pennsylvania*, $43; *Alabama*, $50@$51; *Illinois* and *Indiana*, $52.

ZIRKITE—Per lb., powdered, 65@70 per cent ZrO_2, 3½c. Brick, straights, 80c.@$1 each.

Iron, Steel, and Coke

IRON—Per gross ton, Valley furnaces: Bessemer, $18; basic and No. 2 foundry, $17.

STEEL—Per gross ton, base prices, Pittsburgh, billets and slabs, $31; plates and structural shapes per 100 lb., $1.60; soft steel bars, $1.60@$1.65.

COKE—Per ton, Connellsville furnace, $2.60. Connellsville foundry, $3.50@$4.85. Byproduct coke, Ohio and Kentucky (Connellsville basis), $5.50; Buffalo and Detroit, $8@$8.50; Birmingham, $5.

[1]Price furnished by Foote Mineral Company, Philadelphia.